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NATIONAL HISTORIC LANDMARK PROGRAMS

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FILE (PROPERTY) Name: WEST POINT FOUNDRY ARCHEOLOGICAL SITE

Location – State: NEW YORK

Location – County/Parish: PUTNAM

1. NAME AND LOCATION OF PROPERTY

Historic Name: WEST POINT FOUNDRY ARCHEOLOGICAL SITE

Other Name/Site Number: West Point Foundry; Cold Spring Foundry; West Point Foundry Preserve; New York State Office of Parks Recreation and Historic Preservation (NYS OPRHP) Site Number 07942.00001; National Register Information System Identification Number 10000059 (as *West Point Foundry Archeological Site*; listed February 25, 2010); National Register Information System Identification Number 73001250 (as *West Point Foundry District*; listed April 11, 1973)

Street and Number (if applicable): 80 Kemble Avenue

City/Town: Village of Cold Spring **County:** Putnam **State:** New York

2. SIGNIFICANCE DATA

NHL Criteria: Criteria 1 and 6

NHL Criteria Exceptions: N/A

NHL Theme(s):
I. Peopling Places
- 3. migration from outside and within
- 4. community and neighborhood

IV. Shaping the Political Landscape
- 3. military institutions and activities

V. Developing the American Economy
- 4. extraction and production
- 5. workers and work culture

VI. Expanding Science and Technology
- 1. experimentation and invention

Period(s) of Significance: 1817–1867

Significant Person(s) (only Criterion 2): N/A

Cultural Affiliation (only Criterion 6): Historic-Non-Aboriginal

Designer/Creator/Architect/Builder: N/A

Historic Contexts: *Labor Archeology of the Industrial Era Theme Study*
XII. Business
- A. Extractive or Mining Industries
  - 1. Iron and Ferro Alloys

XVIII. Developing the American Economy
- G. Industrial Production Processes

XXX. American Ways of Life
E. Ethnic Communities
J. Occupational and Economic Classes

3. WITHHOLDING SENSITIVE INFORMATION

Does this nomination contain sensitive information that should be withheld under Section 304 of the National Historic Preservation Act?

_X_ Yes

__ No

4. GEOGRAPHICAL DATA

1. **Acreage of Property:** 90.8 acres

2. **Use either Latitude/Longitude Coordinates or the UTM system**:

Latitude/Longitude Coordinates:
Datum if other than WGS84: North American Datum 1983 (NAD 1983)
(enter coordinates to 6 decimal places)

UTM Zone 18N **Datum** NAD 1983

UTM References:

Old Foundry Parcel

Point	Easting	Northing
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Old Foundry Parcel 2

Point	Easting	Northing
[redacted]	[redacted]	[redacted]

3. Verbal Boundary Description

The West Point Foundry Archeological Site (or the site) is located within the Village of Cold Spring, Putnam County, New York, and comprises approximately 90.8 acres (36.7 hectares) entirely in the ownership of Scenic Hudson Land Trust, Inc. (Scenic Hudson; SHLT).[1] The proposed National Historic Landmark (NHL) boundary of the West Point Foundry Archeological Site consists of two, discontiguous parcels: a larger eastern parcel (legal survey name: *Old Foundry Parcel*) that comprises 90.1 acres (36.5 hectares) and has been designated by Scenic Hudson as the *West Point Foundry Preserve* and a separate, smaller western parcel (legal survey name: *Old Foundry Parcel 2*) that comprises 0.7 acres (0.3 hectares). The two parcels are separated by an approximately 40-foot (12-meter) wide double-tracked railroad corridor operated by Metro-North Railroad.

<u>Old Foundry Parcel</u>
UTM (Universal Transverse Mercator) Point 1 of the Old Foundry Parcel is situated at the extreme western end [redacted]

[redacted]

[1] In the following NHL nomination form, *the site* refers to the West Point Foundry Archeological Site as an archeological site, whereas *Foundry* is shorthand for the West Point Foundry itself during its period of historical operation (1817 to ca. 1911).

[2] See list provided in Section 4.2 above for UTM coordinates of the described reference points; Point 1 for the Old Foundry Parcel matches approximately the location listed as *Point of Beginning* on 2016-dated survey plat mapping (Badey & Watson 2016). The legal survey names of the parcels are provided here with reference to this plat mapping for the overall historic property and do not reflect archeological designations or archeological descriptions of either parcel.

[redacted]

Old Foundry Parcel 2
[redacted]

4. Boundary Justification

The proposed West Point Foundry Archeological Site NHL boundary encompasses the existing Scenic Hudson property parcels of the West Point Foundry Preserve and Foundry Dock Park that together bound 90.8 acres (36.7 hectares) of upland area, Foundry Brook, a portion of Foundry Cove, Foundry Cove Marsh, and the upland area of the West Point Foundry's former 1848 Hudson River dock, as of July 1, 2017. The discontiguous parcel boundaries of the West Point Foundry Preserve and the Foundry Dock Park encompass the entirety of the former West Point Foundry's primary ironworking, ironmaking, and river dock activity areas. The West Point Foundry Preserve parcel [redacted]

Since 2010, the total acreage of the West Point Foundry Preserve parcel (Old Foundry Parcel) has been reduced to its current figure of 90.1 acres (36.5 hectares), with no loss in part or in whole of the former West Point Foundry's ironmaking, ironworking, or workers' housing activity areas that contribute to the site.

5. SIGNIFICANCE STATEMENT AND DISCUSSION

Summary

The West Point Foundry Archeological Site encompasses the intact archeological remains and deposits of the ironworking, ironmaking, and habitation areas of the former West Point Foundry, a privately owned industrial enterprise active between 1817 and circa (ca.) 1911 on the Hudson River in Cold Spring, New York.[3] From 1818 through the close of the Civil War, the West Point Foundry was a leading supplier of ordnance to the United States Army (US Army; Army) and the United States Navy (US Navy; Navy).[4] Moreover, during this period major American foundry and ironworking industries such as West Point Foundry were critical to the transformation of the American economy with the expansion of technological developments in the manufacture of capital goods, which acted as catalysts in that transformation. Consequently, the technological systems of the West Point Foundry and its skillful management reinforced the expansion of the antebellum national economy as well as its defense. Its unique industrial arrangements including, among other things, vertically integrated production processes and an extensive water-powered energy source, made it particularly competitive amongst similar complexes of the time. In recognition of its importance to the historical development of the United States, the West Point Foundry Archeological Site is nominated as an NHL in accordance with Criteria 1 and 6, under the NHL Thematic Framework categories of Shaping the Political Landscape in the area of military institutions and activities, Developing the American Economy in the area of extraction and production, and Peopling Places in the area of archeology, historic-non-aboriginal.

In 1817, a group of New York business and military interests, led by Gouverneur Kemble (1786–1875), established the West Point Foundry in Cold Spring, New York (Rutsch et al. 1979:34 [also *CRMS study* or “Ed Rutsch” survey]; Walton 2009a). Chartered by the State of New York the following year under the corporate entity of the *West Point Foundry Association*, the new foundry in the Hudson River Valley included a woodworking shop for making foundry patterns, a moulding shop for casting cannon, and a water-powered boring mill for finishing cannons. To create space for the Foundry’s layout, the West Point Foundry Association cleared a wooded ravine, and to generate power, they drew water from nearby Margaret Brook through an extensive waterpower system. No early or later records clearly indicate an exact planned layout for the Foundry but its early make-up and later additions suggest waterpower resources, topography, and spatial constraints influenced the growth patterns of the industrial site over time.

The Foundry also provided housing for its workers, building residences on adjacent Rascal and Vinegar Hills, and a manager’s dwelling on a terrace overlooking the Foundry. As the Foundry’s output grew during the 1820s, the West Point Foundry Association erected a blast furnace on site for making pig iron suited for ordnance. By 1839, with Robert P. Parrott (1804–1877) as superintendent, the West Point Foundry Association expanded the Foundry with the addition of dedicated activity areas for a machine shop and an enlarged blacksmith and forging shop (Rutsch et al. 1979:99–114). Following the ca. 1839 expansion, the layout and capabilities of the Foundry largely remained unchanged through the period of the Civil War.

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[3] The West Point Foundry Archeological Site (NR Information System ID# 10000059) was listed in the National Register in 2010, while essentially the same property was listed in the NR in 1973, identified only as the *West Point Foundry District* (as a historic resource) (Barry 2009; Weaver 1972; NR Information System ID# 73001250). The property boundary description of the later West Point Foundry Archeological Site encompasses the property description provided in the earlier NR nomination form.

[4] Beginning in the mid-nineteenth century, a common American military term for a cannon in field service was an “artillery piece,” whereas “rifle” or “rifles” specifically denoted *rifled* cannon (a discussion on rifling follows below). A *gun* could refer to an ordnance piece that was smoothbore (or *unrifled*) with guns more common to naval vessels or deployed in seacoast fortifications. However, many authors, both period and later, employed the term *gun* in general reference to any ordnance piece, rifled or smoothbore. The term *ordnance* is used in this document as a general reference for cannons, whether smoothbore or rifled.

The West Point Foundry is significant for its distinguishing contributions to the outcome of the Civil War through its steady supply of state-of-the-art cast-iron cannons and ammunition to the Army and the Navy. The Foundry's production during the Civil War included all models of the well-known *Parrott gun* and its munitions, designed by the director of West Point Foundry, Robert Parker Parrott. It also included other types of important heavy ordnance which saw service in nearly every major field engagement of the conflict such as the naval guns mounted aboard the USS *Monitor* and the infamous "Swamp Angel." The Parrott gun was among the first widely used field artillery piece with a rifled barrel, which improved the accuracy, range and striking velocity over traditional smooth-bore weapons of a similar type. The widespread adoption of the Parrott gun ushered in a new era of long-distance warfare, rendering obsolete strategies and built-defenses of traditional siege warfare such as masonry fortifications (Bruce 1956, Grossman 1994:222; Manucy 1949). Through newspaper outlets such as *Harper's Weekly*, the West Point Foundry gained national attention in the early years of the war for making cannon of advanced design. In June 1862, the Foundry hosted a tour by President Abraham Lincoln following a meeting with General Winfield Scott at the United States Military Academy at West Point on the opposite side of the Hudson River. At this tour, Lincoln witnessed the processes of Parrott gun construction as well as an impressive demonstration of its long-range accuracy. Soon after this visit, the proved weapons were rushed to McClellan's army as it fought near Richmond (Bruce 1956:187–188).

Ironworking firms like that of the West Point Foundry, characterized as dynamic, sprawling, and operated by a diverse workforce of skilled and unskilled labor, were key to the industrialization of the American economy by the mid-nineteenth century (Hunter 1985; Meyer 2006; Pursell 1969). With markets supplied by heavy industry—whether for ordnance or marine steam engines—expanding and contracting in often erratic ways in the antebellum period, the ability of the West Point Foundry to adjust to depressed demands for military and capital goods permitted continuity in its manufacturing capacity and the retention of skilled workers (Pursell 1969:102). Previous research on the importance of these industries is helpful for highlighting the influence of the West Point Foundry in the transition of the American economy. Anthony F. C. Wallace points out in *Rockdale*, his ethnographic study of early American industrialization in a rural eastern Pennsylvania town, that antebellum industries were enlarging the national economy as they not only produced finished or semi-finished goods, such as sewing machines and textiles, for emerging consumer markets but also made heavy capital equipment, necessary for making consumer goods themselves (1978).

To clarify, steam engines for waterborne vessels and railroad locomotives led to decreasing costs and shortened travel times for moving people and freight in the antebellum period (Meyer 2003; Sellers 1991). During the same period, the growing availability of power generation from stationary steam engines and water turbines that drove new types of machinery led to decreasing costs in the manufacture of consumer goods, most notably foodstuffs, textiles, and agricultural equipment, through increasing scales of production. Coupled together, the falling costs of transportation and manufacture contributed to the nation's transition from regionally situated agrarian economies of the late eighteenth century to an increasingly nationally oriented market economy driven by consumers at the time of the Civil War (Meyer 2003). The West Point Foundry was an early leading maker of steam engines, locomotives, and machinery and in the present, the West Point Foundry Archeological Site represents well the Foundry's role in the nation's economic transformation of the nineteenth century.

The scale of West Point Foundry's role and productivity as a major American supplier of ordnance and capital goods was shared with only three other foundries in the nation: the South Boston Iron Company in Boston, Massachusetts, the Fort Pitt Foundry in Pittsburgh, Pennsylvania, and the Tredegar Iron Works in Richmond, Virginia. However, the adaptation of ironworking technologies in a rural setting with reliance on waterpower set the West Point Foundry apart from its competitors in ordnance- and machinery-making; the addition of a blast furnace to its layout made it stand out even further. Taken together, these capabilities helped the West

Point Foundry meet the manufacturing challenges of the era and earned it a national reputation for innovation and versatility. In comparison with its peers, the West Point Foundry Archeological Site is the only site of a major Civil War-period ordnance maker to retain sufficient integrity to permit both extensive archeological research as well as public interpretation.

The site's significance under Criterion 6 is owed to the research value and high integrity of its subsurface remains and its largely intact setting. Successive owners of the West Point Foundry after the Civil War struggled to replicate their predecessors' longer-term achievements in making cannons and machinery and by ca. 1911, the Foundry had ceased operation altogether. In the years following its abandonment, most of the buildings and structures of the site were removed through salvage but foundations and traces of activity areas remained intact beneath accumulating masonry decay and soil. It was not alone, however, as both the South Boston Iron Company and the Fort Pitt Foundry never recovered their own earlier successes and each had ceased operation by the twentieth century, but their respective sites were intensively redeveloped. Despite the destruction of much of Richmond at the close of the Civil War, the Tredegar Iron Works survived intact and remained profitable into the twentieth century; yet its success led to repurposing of the property for new industrial uses over time that removed much of its earlier industrial structures and features. Consequently, despite their historical importance, the archeological research potential of the other three major Civil War-period foundries has largely been lost through demolition or redevelopment.

The West Point Foundry Archeological Site expresses the West Point Foundry's rich history and its national influence and stands out as the only intact site of its kind that is open to study through historical and industrial archeology. Archeological investigations carried out between 1979 and 2008 of the site have demonstrated that it possesses a substantial body of material culture that includes well-preserved stratigraphy, artifact assemblages situated both in worksite and domestic areas (hereafter referred to as *activity areas*), numerous intact structural features, and in situ deposits of waste and by-product materials with demonstrated research value. This archeological record provides information frequently missing in period primary or secondary sources and can provide answers to questions regarding the development of waterpower and landscape resources for ironworking in the nineteenth century; the adaptation of ironworking technologies (such as those employed for making Parrott guns) that were pivotal to industrialization; the roles of workers in expanding industry through foundry and ironworking technologies; and the personal lives of many of those same workers as captured in the sites of nearby households. For instance, archeological research of the West Point Foundry Archeological Site could answer questions such as, how did workers adapt ironworking practices to make cannon and steam engines across the same industrial site? Did workers become more or less specialized as the West Point Foundry adopted novel technologies over time? How does the labor culture of workers translate into the material culture of their domestic lives?

The West Point Foundry Archaeological Site was listed in the NR in 2010 under Criteria A and D. As a NR-listed property proposed for NHL designation, the site meets Criteria 1 and 6 of the *Specific Criteria of National Significance* provided under 36 CFR § 65.4 (a). With respect to Criterion 1, the West Point Foundry Archeological Site – as it represents the West Point Foundry – conveys the influence of the property on trends and events in the nation's military and political history from 1817 to 1867, and its contributions to the expansion of American industry and commerce during the same time frame. Two themes in the National Park Service's *Revised Thematic Framework* guidance provide support for designation of the property under Criterion 1: (IV) Shaping the Political Landscape: Military Institutions and Activities and (V) Developing the American Economy: Extraction and Production (National Park Service [NPS] 2000a).

Regarding Criterion 6, previous archeological investigations of the West Point Foundry Archeological Site have yielded information on foundry and ironworking practices significant to the nation and labor culture rooted in national historical trends of the early to mid-nineteenth century. The West Point Foundry Archeological Site offers unique and irreplaceable opportunities for investigating the evolution of foundry and ironmaking technologies and the material culture of labor that are together underrepresented in the study of antebellum American history and culture. Unique aspects of the site including its isolated single-industry setting, vertically integrated industrial process, system of patriarchal control and mixture of skilled and unskilled labor provide a valuable underrepresented setting to contribute to broader knowledge of such historical phenomenon. Evidence in support of significance under Criterion 6 is demonstrated through two themes provided in the Revised Thematic Framework guidance: (I) Peopling Places: Archeology, Historic-Non-Aboriginal and (VI) Expanding Science and Technology: Extraction and Production (NPS 2000a). The application of both themes to the West Point Foundry Archeological Site according to Criterion 6, and industrial archeological properties in general, is further highlighted by discussions in the NHL Theme Study, *Labor Archeology of the Industrial Era* (Fracchia and Roller 2014:46–47), summarized below.

Historic Context

The following discussion offers an overview of the technological context and history of the West Point Foundry, beginning with summaries of the chief types of ferrous metals, and the historical methods to make and work them into useful goods. Some of the iron- and steelmaking processes outlined in the following discussion, such as wrought iron puddling and large-scale steel manufacture, were not carried out at the West Point Foundry. A brief review of their development in the United States provides however a framework to highlight the operation of the West Point Foundry and clarify the methods of ironmaking and ironworking that were present at the Foundry and those that were not. In this discussion, *ironmaking* refers to those processes in which workers rendered ferrous metals, such as wrought iron, cast iron, and steel, from raw or semi-finished materials, like iron ore, while *ironworking* refers to methods in which skilled workers shaped and fitted iron metals into finished goods. This discussion is intended to provide focused context for the national significance of the West Point Foundry Archeological Site.

<u>Ironmaking, 1600–1850</u>

By 1600, wrought iron, cast iron, and to a lesser extent, steel, were in common use among Europeans (Mulholland 1981). Differences between the three chief ferrous metals are found in the amounts of iron, silica (i.e., silicon oxide), and carbon that make up each, while sulfur, phosphorus, and manganese can influence their shaping, or *working* properties (Gordon 1996). Each ferrous metal offered advantages for specific uses. Wrought iron is an alloy of iron and silica and was valued by blacksmiths for its malleability (or, *ductility)* and toughness (i.e., difficult to break). Wrought iron could be forged and shaped through heating and physically working into its intended shape, such as a door hinge or nails. Cast iron is an alloy of iron and carbon (with about two to four percent carbon by weight) and has properties that are suited for objects that remain rigid in use, such as cookware, bells, cannons, and steam engine piston cylinders. Steel, also an iron-carbon alloy (with one to two percent carbon by weight), is harder than wrought iron and more wear-resistant. It has many distinct advantages over wrought iron for regular use, but prior to the advent of large-volume, specialized manufacturing processes in the mid-nineteenth century (namely the Bessemer process), the manufacture of steel was constrained to small-batch processes and was therefore considerably costlier to manufacture than wrought iron. For this reason, wrought iron and cast iron remained the most common ferrous metals manufactured during the eighteenth and much of the nineteenth centuries in Europe and North America (Gordon 1996:9–10).

Europeans introduced three types of ironmaking sites to their North American colonies that matured into a robust iron industry by 1800. For making wrought iron directly from iron ore, artisans used a *bloomery hearth*. For making cast-iron goods and pig iron, artisans used a *blast furnace*. To make wrought iron from pig iron, artisans would use a *finery forge* (sometimes labeled an *indirect process* by industrial archeologists and historians of technology) (Mulholland 1981:31–32).[5] By the mid-nineteenth century, finery forges had largely been replaced by puddling furnaces in the production of wrought iron.

Bloomeries

Bloomery smelting was the earliest of the three methods and required the least capital (Gordon 1996:14). In a bloomery hearth, or simply a *bloomery*, the ironmaker, or *bloomer*, placed iron ore in a small shallow masonry hearth, fired with charcoal, and supplied with a forced draft from a bellows. The rapid combustion of charcoal in contact with the iron ore formed a mass, or *bloom* of white-hot iron entrained with silica-laden slag. Artisans would remove the bloom from the hearth and consolidate it through hammering to more evenly distribute long stringers of slag through the iron that imparted toughness in the metal. Bloomery ironmaking sites frequently featured a water-powered hammer to shape blooms into usable wrought-iron products. Due to its relative simplicity and low cost, a single artisan could operate a small bloomery (Gordon 1996:14). No bloomery forges have been identified at the West Point Foundry but considering the presence of such sites throughout the southern Hudson River Valley region in the early to mid-nineteenth century, it is likely that the Foundry consumed wrought iron made at bloomery forges during its earliest decades of operation (Ransom 1966).

Blast Furnaces

Blast furnaces were larger, more complex sites than bloomeries. A blast furnace required more workers to tend it, and it occupied a much larger footprint in space, and landscape and resource needs (Gordon 1996:14). Much like a grist, saw, or woolen mill of the early industrial period, a typical blast furnace was located adjacent to a flowing stream of water. The gravity of water, delivered by a channel or raised flume (called a *headrace*), turned a waterwheel that in turn powered the bellows or blowing engine that drove a blast of air into the hearth of the furnace located near the base of the furnace stack.[6]

Usually built of stone before the nineteenth century, North American blast furnaces resembled a narrow, truncated pyramid with battered walls, a level top, and an arched opening in one side of the base for drawing away molten iron. Smelting took place in the cavity, or *shaft*, built into the center of the furnace that extended from a narrow opening at the top to the hearth at the base of the furnace. Apart from proximity to resources like charcoal and iron ore, topography was crucial to siting a blast furnace as slopes or embankments made for a natural ramp to access the top of a furnace. At the top of the furnace, workers used baskets or hand carts to deposit alternating layers of charcoal fuel, iron ore, and a fluxing agent, often limestone, within the shaft that together formed the *burden* of the furnace.[7]

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[5] *Pig iron* is a term for the basic cast iron-like ingots rendered from a blast furnace. For English-speaking furnace workers in the early modern era (ca. 1500 and later), the appearance of tapping glowing molten iron from a furnace hearth into a channel that fed into shorter, connected channels set in a bed of sand reminded them of a sow suckling her piglets. A more thorough etymological study of the term *pig iron* is lacking from the literature of early modern iron industries, however.

[6] By about 1780, wooden blowing tubs or cylinders replaced bellows at most American blast furnaces. Pistons, seated inside the cylinders, were linked to either side of a walking beam, which was linked to a waterwheel. The reciprocating movement of the pistons in the cylinders generated a draft or blast of air that was fed into the hearth of the furnace through piping.

[7] Blast furnace workers added an alkaline-rich substance, such as limestone or seashells, to the furnace burden to react with, or *flux*, the acidic constituents in iron ore, namely silica. As molten iron accumulated in the furnace hearth, molten silica-rich slag, reacting with the flux, accumulated on the surface of the iron in the hearth and was removed by workers before drawing off the molten iron. Some iron ores contained enough chemically base minerals that they were described as “self-fluxing” by period commenters (Overman 1850).

With the fuel in the burden ignited, the forced draft into the base of the furnace assured steady combustion of charcoal, generating carbon monoxide that, in turn, liberated oxygen from the metallic iron bound in the iron ore. Small droplets of molten iron coalesced about mid-way in the furnace shaft and descended downward to accumulate in the hearth. The high cost of getting a blast furnace into production (or *in blast*) prompted proprietors and skilled workers to keep a furnace in blast for several months at a time, sometimes years if possible; a dozen or more workers were tasked with keeping a furnace operating over these long periods of time, sometimes described as *campaigns*. Within a building abutting the base of the blast furnace called a *casting shed* or *house,* workers directly poured molten iron tapped from the hearth into sand molds to make finished products, such as stoves or kettles, or to make pig iron in a bed of level sand enclosed by the casting shed (Gordon 1996:14). The blast furnace of the West Point Foundry largely adhered to this general design, layout, and operation.

By the mid-nineteenth century, iron-shelled blast furnaces began to replace stone-lined stacks, and the practice of erecting a furnace next to a hill also became less common, as elevators replaced charging bridges for loading iron ore and fuel into the tops of furnaces. By 1850, blast furnace owners in Pennsylvania and Maryland, adopting proven British smelting techniques and technologies, successfully smelted iron ore with anthracite coal and coke made from bituminous coal, lessening the dependence on charcoal for fuel (Gordon 1996; Paskoff 1983).

Their reliance on waterpower also declined, as steam engines increasingly replaced waterwheels to drive blowing engines. Such transformations liberated a key component of the iron industry from topographic restraints, making it feasible to locate a blast furnace closer to markets, even in heavily populated urban areas where industrial demand was the highest. These evolutionary changes in the iron industry coincided with and fostered ever-growing demand for wrought and cast-iron goods, which included a range of domestic goods, such as stoves and farming implements, to heavy capital equipment, such as steam engines, locomotives, and machine tools (Gordon 1996:17; Temin 1964:3).

<u>Finery Forges and Puddling Furnaces</u>

Before the nineteenth century, skilled workers converted pig iron into wrought iron at *finery forges*. A finery forge featured a specialized hearth and a forced draft, much like that of a bloomery forge. In a finery forge, artisans called *finers* exposed pig iron in a charcoal fire heated to great intensity with a blast of air provided by bellows. This process oxidized the carbon and much of the silicon within the pig iron, rendering a mass or *loup* of semi-molten iron, rich with slag. Finers then worked and consolidated a loup into usable wrought iron with a water-powered hammer, just as a bloomer did when making wrought iron at a bloomery (Gordon 1996:14).

The operator of a finery forge often used a water-powered rolling mill adjacent to the forge to shape rough bars of wrought iron into finished bars, rods, plates, and sheets of various dimensions for sale to blacksmiths and other metal workers. Fining, first introduced to the American colonies ca. 1647 in Massachusetts at the Hammersmith site in Saugus, could be more economically advantageous since it was often less expensive to transport pig iron to a forge site than hauling iron ore and fuel to a bloomery forge (Hartley 1957). The process, however, required more capital and skilled workers that were both often in short supply in the colonial period (Gordon 2001:126).

The volume of wrought iron manufactured in the United States greatly increased with the advent of the *puddling process* in the early nineteenth century. Developed by British ironmakers in the 1780s, the puddling process featured a horizontal three-part brick furnace; mineral coal or coke, combusted in a chamber at one end of the furnace, generated heat that was drawn over a charge of pig iron set into the middle of the furnace, while a square brick chimney set at the far end of the furnace developed a natural draft strong enough to rapidly combust the coal, drawing immense heat over the pig iron and melting it (Gordon 1996).[8] Separation of the combustion chamber from the pig iron charge prevented high quantities of sulfur released from the combusting coal from becoming entrained in the iron.[9] A *puddler* worked and stirred the near-molten mass of pig iron with a long-iron tool called a *rabble* inserted through a port set into the furnace wall. The action of the puddler progressively oxidized the carbon in the pig iron, rendering a pasty bloom of wrought iron that was drawn from the furnace. After mechanically squeezing the bloom into a rough bar shape, ironworkers further shaped blooms into rods, bars, rails, plates, and sheet-iron in a rolling mill adjacent to the puddling furnaces. Though labor intensive, puddling required less refined skill than bloomery or finery smelting and it marked a significant savings in fuel costs, especially in those regions where mineral coal was more plentiful than wood (Temin 1964:3). The West Point Foundry did not include puddling furnaces or a rolling mill (unlike the Tredegar Iron Works in Richmond) and purchased its puddled wrought iron from other makers.

Blacksmithing

During the eighteenth and nineteenth centuries, separate industries and skilled workers focused on making goods from wrought and pig iron. Two of the more common of these industries were blacksmith shops and foundries. Blacksmiths typically worked with wrought iron, forging (heating and shaping) the metal to fabricate and repair a wide variety of items, from horseshoes to architectural hardware, or small machine parts and blacksmith tools themselves. Prior to the advent of mass-production and less-permanent consumer culture in the late nineteenth century, blacksmiths were essential to the daily lives of rural and urban dwellers alike for making and repairing tools, farming implements, cooking utensils, and other goods. For this reason, blacksmith shops, or *smithies*, were common in villages, towns, and cities throughout America, from the colonial era through the early twentieth century. Blacksmith shops were often small affairs, comprised of only one or a few smiths and their apprentices, with a single forge and anvil sufficing for many. Blacksmithing was also integrated into larger industries, such as textile mills, railroad shops, machine shops, and foundries, where larger forging work contributed to overall production and machine maintenance. The West Point Foundry included an extensive blacksmithing and forging shop for making machinery components such as connecting rods for steam engines.

The Disruption of Steel

Manufacturing high-quality wrought iron consistently on a large, cost-effective scale used a difficult process, and one that vexed manufacturers well into the nineteenth century. The puddling process, developed in the late eighteenth century, remained the primary method of wrought-iron production some 100 years later. Although an improvement over previous methods, puddling remained laborious, time-consuming, and resistant to scaling, causing a bottleneck in the chain of supply and demand. Numerous attempts to mechanize the process ended in failure and frustration. Ultimately, it was an attempt to improve this process that led to the replacement of wrought iron with steel (Misa 1995).

[8] More widely adopted in the manufacture of pig iron in Great Britain in the mid-eighteenth century, *coke* is a byproduct of the distillation of bituminous coal. Distillation through heating, or *coking*, in specially built enclosed retort-type ovens drives off volatile organic compounds bound within raw bituminous coal that are undesirable in the manufacture or refining of iron and steel. Coke, the silvery and porous fixed carbon residue of coking, combusts more cleanly than raw coal and can withstand a greater weight of iron ore than charcoal without significant crushing that would otherwise slow or block the upward flow of blast in a furnace shaft (Lankford et al. 1985).

[9] Mineral coal and coke can impart excessive quantities of sulfur into iron during smelting and refining processes, causing brittleness, or *hot shortness*, in iron when its heated for further working (Gordon 1996:7). For this reason bloomeries and fineries, which required contact between fuel and iron ore or pig iron, relied on charcoal for fuel which contains far less sulfur than mineral coal and coke.

Having a fascination with military technology, English inventor Henry Bessemer set about to improve iron for the manufacture of ordnance. As the size of puddling furnaces limited the ability to increase the scale of the process, he searched for methods to improve its efficiency. Bessemer surmised that a blast of air, directed upwards through a bath of molten pig iron, might increase the temperature of the bath and decrease carbon content while simultaneously eliminating the time-consuming stirring process involved with puddling. Bessemer's experiments produced striking results. The product that poured from his experimental furnace was a malleable iron with very low carbon content. Bessemer's product was not quite wrought iron, as it did not contain fibrous threads of slag. The converted iron was prone to oxidize faster than wrought iron but it rolled like wrought iron, could be forged, and proved tougher than wrought iron. Bessemer called his converted iron, "mild steel" and his method of making steel became known as the *Bessemer* or *pneumatic process.* With encouragement from others, he patented his process and its essential egg-shaped converter in 1856 (Knowles 2013:221; McGannon ed. 1964:24–25).

Concurrent with Bessemer's experiments, German-born engineer Carl Wilhelm Siemens developed the open-hearth method of making steel. By 1865, Siemens was making large quantities of steel from pig iron and iron ore. His process used intense heat to eliminate carbon, manganese, and silicon from pig iron. Siemens' open-hearth process was slower than that of Bessemer's, but it had an advantage in that it maintained closer control over reactions within the steel, allowing them to adjust and sample the carbon content while the metal remained in a molten state. In a license agreement with Siemens, French engineer Pierre-Emile Martin built an open-hearth furnace in Sireuil, France, in 1863. Using the open-hearth method, Martin enhanced the Siemens process, producing new steel from melted scrap steel and pig iron (Misa 1995; Gordon 1996:226; Kobus 2015).

The implications of the Bessemer process and the Siemens and Siemens-Martin open hearth processes were far-reaching. While a puddling furnace produced approximately 550 pounds of wrought iron in two hours, Bessemer's converter produced roughly the same quantity of mild steel in less than 30 minutes. The size of the converter had no effect on the production time, meaning that a larger converter simply made more steel in the same 30-minute span. In addition, the converter and open-hearth processes used considerably less fuel than previous methods of iron and steel production. Consequently, what had once been a costly material, used only sparingly, steel became one of the least expensive metals to manufacture (Raymond 1986:184).

Under license from Bessemer, numerous steel makers began operation in the United States in the years immediately following the Civil War. Among the investors in the Bessemer process was Andrew Carnegie, whose immense steel and rolling mills in the Monongahela River valley south of Pittsburgh revolutionized large-scale steel production (Kobus 2015:87–148). By the late 1870s, American steel manufacturers employed the Siemens-Martin open hearth process on a growing scale. Bessemer converters and open-hearth furnaces proved indispensable for meeting the ever-growing demand for steel railroad rails, bridges, structural members, railroad car and locomotive parts, ships, and increasingly, ordnance for field artillery and warships. Indeed, the advent of Bessemer converters and open-hearth furnaces made steel production one of the largest, most dynamic industries of the nineteenth century (Gordon 1996:224–28).

With the success of low-cost steel came a decline in demand for wrought iron, as well as for some products previously made from cast iron, such as cannon barrels. By 1900, steel largely replaced wrought and cast iron in numerous areas of manufacture and heavy construction, including heavy ordnance, the railroad industry, and ship and skyscraper construction. Initially, the production of pig iron for the manufacture of steel continued unabated at separate blast furnaces. Gradually, however, steel producers integrated iron smelting into their overall operations, eliminating the need for separate blast furnaces devoted to pig iron production (Gordon

1996:228). At present, the remaining operational blast furnaces in the United States are exclusively within integrated steel plants.

Cast iron, as a standalone product, remained essential for a great number of items and most large-scale manufacturers that built machines or parts requiring cast iron, such as automobile manufacture, included a foundry within their industrial plants. However, as machinists and precision machining replaced blacksmithing, the demand for wrought iron lessened. The transition to steel negatively impacted older ironworking enterprises that were not well positioned to adapt to new technology and changing markets (Knowles 2013:237–239). No written sources or archeological evidence suggest that the West Point Foundry incorporated steelmaking into its layout, while the rapid adoption and manufacture of all-steel ordnance in the late 1880s by the Army and Navy undermined the Foundry's ability to effectively compete for ordnance contracts, depriving its owners of a chief source of revenue and marketplace identity.

<u>Iron Foundries</u>

While blacksmiths were skilled in shaping wrought iron, they typically devoted little or no attention to casting molten iron into parts or *castings*. The casting of pig iron, like casting brass and bronze, took place in foundries that used special furnaces which consumed charcoal or mineral coal for fuel (Trepal 2008). A foundry typically acquired its supply of pig iron from a wholesale dealer, who in turn acquired pig iron from blast furnaces nearby or abroad. Foundries could be large or small operations, and could be sole proprietorships or integrated into a larger ironworking plant, such as a locomotive manufacturing shop. The basic equipment and labor of an iron foundry of the early nineteenth century remains much the same in the present.

Foundry work began in a pattern shop, where skilled woodworkers carved and assembled patterns from wood, matching the dimensions provided in plans and descriptions. To make an iron casting, patterns were temporarily imbedded in fine sand in a two-part box (called a *flask*) to create an impression of the item being cast. This work was carried out by skilled workers called *moulders* (or sometimes, *molders*) in a moulding *house* or *shop*. The sand and clay for making molds was often excavated from near a foundry site, especially in alluvial riverine settings such as that surrounding the West Point Foundry.

Nineteenth-century foundries featured vertical shaft furnaces, called *cupola furnaces* (Bolland 1894). Cupola furnaces operated much like blast furnaces, with alternating layers of fuel, often mineral coal, and pig iron charged into the top of the furnace, and a steady blast directed through a chamber called a *wind box* fixed around the base of the furnace. Molten pig iron gradually accumulated at the bottom of the furnace, where workers drew off the metal into ladles. An air furnace (sometimes called a *reverberatory furnace*) was another type of furnace foundries employed in the nineteenth century. An air furnace was similar in layout and operation to a puddling furnace: the intense heat from the combustion of mineral coal, set at one end of the furnace, was drawn over a chamber charged with pig or scrap iron, and up through a chimney built into the opposite end of the rectangular furnace (Bolland 1894). Sulfur in both anthracite and bituminous coal was a detriment to iron castings, so the gun foundries (including the West Point Foundry) used air furnaces in the production of ordnance as they imparted much less sulfur into cast iron compared to cupola furnaces (see page12, footnote 9); however, they consumed much more coal than cupola furnaces to melt the same charge of iron and therefore were costlier to operate. Several cupola and air furnaces were in use at the West Point Foundry in the moulding shop area throughout its period of national significance and later.

Sometimes within the moulding shop or in a separate *casting* shop, foundry workers, or *founders*, poured molten metal into prepared flasks. After cooling and removal from its flask, a casting could be further machined to meet its intended dimensions. Articles commonly cast at a mid-nineteenth century foundry included stoves, window sash weights, gears, machine and steam engine parts, and farming implements like plow shares (Bolland 1894). By the mid-nineteenth century, machine and blacksmith shops had become key features of many multifaceted foundries. Castings for precisely fitted parts, such as steam engine pistons and cylinders, required machining to refine rough castings to form the narrow gaps (or tolerances) between two or more moving parts in an assembly (Gordon and Malone 1994; Hounshell 1984). The West Point Foundry featured both an industrial-scale blacksmith shop and an extensive machine shop (or *turning* shop) by the Civil War for shaping and finishing parts for steam engines and cannon alike.

In the early to mid-nineteenth century, foundries specializing in the manufacture of ordnance, or *gun foundries*, typically included the basic activity areas of a foundry but also featured a boring shop or mill to finish cannons (Herzberg 2005; Trepal 2008). In a boring shop, skilled workers mounted an unfinished cannon tube on a horizontally oriented rack or *bed*; while fixed to the boring bed, the cannon tube was rotated about its short axis by water or steam power while a hardened bit was gradually driven against the solid casting to drill and ream out the bore of the cannon. The boring mill of the West Point Foundry was one of its chief activity areas and housed its largest waterwheel.

The wide array of processes and machinery that comprised a foundry required varied skill sets. Large foundries employed a great many artisans and laborers, from furnace tenders, moulders, and founders to draftsmen and pattern makers, machinists, and the apprentices and unskilled workers that assisted the skilled artisans. Much like large blast furnace operations for making pig iron, entire neighborhoods and communities grew around some of the more substantial foundry operations in the nation.

From blast furnaces to foundries, the American iron industries employed many highly skilled workers by the mid-nineteenth century. Veteran ironmakers and ironworkers were well-regarded by their communities as the extreme physical challenges, dangers, and innumerable technical facets and complexities of making and working iron required considerable strength, stamina, and intelligence, little of which was captured in written records at the time (Johnson 2009). The intact subsurface resources of the West Point Foundry Archeological Site likely contain data which can illuminate some of these work practices and conditions.

The almost imperceptible transformations within iron smelting and ironworking processes required an intimate knowledge and feel for the work, which could only be obtained through many years of observation and practice. Not until the late nineteenth century did metallurgists and engineers identify the physics and chemistry underlying processes long understood by ironmakers and ironworkers. These arts, which depended on keen senses and intuition, were not easily translated into the scientifically driven processes of mass production. For this reason, American iron industries remained the domain of skilled workers throughout much of the nineteenth century (Gordon 1996:2).

Federal Support for Gun Foundries

In 1800, the United States boasted a substantial iron industry, but in key respects its industrial base lagged behind that of Great Britain and France. Manufacture of armaments for defense, in particular, were unregulated, poorly coordinated, and limited in capacity. The federal government began manufacturing small arms (i.e., muskets, rifles, and pistols) at government-owned armories in Harpers Ferry, Virginia, and Springfield, Massachusetts, by 1800, but direct federal support for the manufacture of ordnance for field and naval service remained lacking through the War of 1812 (Hounshell 1984).

Until the late 1810s, much of the young nation’s field artillery consisted of cannon imported from abroad or captured in conflict, with a modest domestic supply of ordnance provided by small foundries in the Middle

Atlantic states. Consequently, when the United States declared war on Great Britain in 1812, the nation was ill-prepared to match the firepower of its opponent in a longer contest (Gordon 1996:3, 58). When, in 1813, the British raided and destroyed the Principio Iron Works near Havre de Grace, Maryland, they further handicapped Americans' ability to replenish their ordnance. The lessons of the conflict were not lost on President James Madison or his successor, James Monroe, who in the years immediately following the War of 1812 made progress on improving the nation's armaments industries.

In April 1816, Congress passed "an act for the gradual increase of the Navy," appropriating funds to construct a modest fleet of twelve 44-gun and nine 74-gun frigates over several years, although not all planned warships were completed (Peters ed. 1850:321). To make ordnance for the proposed vessels, War Department officials offered contracts to the Fort Pitt Foundry in Pittsburgh, Pennsylvania, the Columbia Foundry in Georgetown, District of Columbia, and the Bellona Foundry, located outside of Richmond, Virginia (Hazlett et al. 2004; Olmstead et al. 1997; Tucker 1989). Through the joint efforts of a group of private investors and the three-member Board of Naval Commissioners, construction of a fourth foundry, the West Point Foundry, began in 1817 to help fulfill the growing need for naval cannon (Walton 2009b).[10]

Unlike Great Britain—which had concentrated much of its ordnance production by the early nineteenth century at government-owned Royal Arsenals like Woolwich in London—the United States federal government remained dependent on private gun foundries until the 1880s for the manufacture of its ordnance and ammunition. Federal contracts for cast-iron ordnance from the 1820s to the 1850s largely originated with the Navy, but the Army also contracted for similar ordnance to supply the growing number of fortifications ringing the nation's three coasts under the "Third System" of seacoast fortification and for siege guns (Hazlett et al. 2004; Tucker 1989). Although Edwin Olmstead and his fellow researchers identified at least 17 ironworking enterprises that were active in fulfilling these contracts on the eve of the Civil War, most were undertaken by the four largest gun founders in the nation by 1860. These included the previously-mentioned Fort Pitt Foundry; the South Boston Iron Company, located in South Boston and founded by Cyrus Alger ca. 1817; the West Point Foundry; and lastly, the Tredegar Iron Works, founded by railroad investors in Richmond, Virginia, in 1837 and later managed by a former Army officer, Joseph Reid Anderson (1997:163).

Apart from the West Point Foundry, the other three major Civil War-era foundries were established solely with private capital, with no direct assistance offered by the federal government at their outset. The earlier Columbia Foundry ceased operation by 1854 and the Bellona Foundry became a marginal ordnance maker by the mid-1850s but saw renewed production during the Civil War as a supplier to the Confederacy (Daniel and Gunter 1977; Gorr 1971/1972).

<u>The West Point Foundry during its Period of National Significance, 1817–1867</u>

Led by Gouverneur Kemble (1786–1875), a politically and socially connected New York merchant, the West Point Foundry Association incorporated in April 1818 (capitalized at $100,000, including $25,000 advanced

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[10] Earlier monograph histories of the West Point Foundry, such as a West Point Foundry-centennial commemoration article written for the New York State Historical Association by Gouverneur Kemble III (a grandson of William Kemble and a great-nephew of Gouverneur Kemble) and the *West Point Foundry Site* report, prepared by Ralph Brill Associates in 1979, have suggested that Monroe's administration provided direct support for the establishment of four-gun foundries after the War of 1812 (Kemble 1916; Rutsch et al. 1979). Recent scholarship, however, has not identified specific Congressional legislation or presidential directives supporting a set number of privately or publicly owned foundry and ironworking enterprises for the manufacture of ordnance in the decades leading up to the Civil War (Walton 2009c). The partly apocryphal *four-foundry* narrative may stem from the preponderance of federal contracts granted to four, but up to six, foundries in the years leading up to the Civil War (Olmstead et al. 1997:163). To clarify, these were the Columbia Foundry, the Fort Pitt Foundry, the Bellona Foundry, the West Point Foundry, the South Boston Iron Company (or sometimes South Boston Iron *Works*), and the Tredegar Iron Works.

from the Board of Naval Commissioners) (Figure 1). The West Point Foundry Association initially consisted of 11 members, with Gouverneur Kemble acting as chief organizer, agent, and guiding hand. In addition to Kemble and his younger brother William Kemble (1790–1881), the Association included a number of prominent businessmen and ordnance experts, including noted engineer and soon-to-be Columbia College professor James Renwick, Sr. (1790–1863); Joseph Gardiner Swift, the first graduate of the United States Military Academy (1783–1865); and interestingly, James Kirke Paulding (1778–1860), a member of the Board of Naval Commissioners from 1815 to 1822, and later Secretary of the Navy under President Martin Van Buren (Barry 2009:13; Grace and Forlow 2014:7; Nelson 1981). Although they had yet to incorporate under a state charter, Gouverneur Kemble and his associates signed their first contract with the Navy in December 1816 (Tucker 1989:65).

At Kemble's discretion, the West Point Foundry Association sited the West Point Foundry at its present location on the east bank of the Hudson River, just south of the small community of Cold Spring in the Town of Philipstown, Putnam County, New York (Maps 3, 4, and 5; Figure 2). Situated in the Hudson Highlands and opposite the United States Military Academy at West Point, the new foundry benefited from the advantage of waterborne transportation and communication with a protected dock in Foundry Cove, waterpower offered by nearby Margaret Brook (later Foundry Brook), and access to local raw materials and commodities. In addition to the principal Cold Spring site, the West Point Foundry Association established a steam engine assembly shop at the northeast corner of West and Beach Streets on the Hudson River in New York City, as well as an administrative office at 17 Whitehall Street, in lower Manhattan (Geismar 1987). The West Point Foundry Association maintained their New York City extension shop until ca. 1839, when the separate facilities were consolidated at Cold Spring (Rutsch et al. 1979).

The precise type and number of furnaces in the Foundry's initial construction remain uncertain, but it likely included one or two cupola furnaces and a pair of air furnaces in the moulding shop by the early 1820s (Rutsch et al. 1979; Trepal 2008a). By 1831, the Foundry's furnaces were fueled with anthracite coal mined in northeastern Pennsylvania and shipped to the Hudson River Valley via the Delaware and Hudson Canal (Lowenthal 1997:113-114). In addition to the moulding shop, the earliest Foundry layout included a boring mill for finishing cannon, a pattern shop, and drafting and administrative offices. Power for the Foundry was provided by an extensive waterpower system, featuring an 8-foot wide (2.4-meter), 36-foot (11-meter) diameter backshot waterwheel built into the boring mill (Finch 2004).

The Foundry enjoyed direct access to the Hudson River with a 300-foot long dock built into nearby Foundry Cove. The dock was of sufficient size to accommodate river sloops that delivered raw materials to the Foundry and transported away its heavy products. Marine vessels remained the Foundry's primary mode of transportation until 1849 when the Hudson River Railroad connected Cold Spring with New York City. The railroad completed a spur to the Foundry shortly thereafter, providing another means of transportation for raw materials and finished products (Rutsch et al. 1979).

By the mid-1820s, the Foundry's managers found it worthwhile to erect a blast furnace on site for making pig iron (Kotlensky 2007; Timms 2005) (Figure 3). Beginning operation in October 1827, the Foundry's stone-clad blast furnace measured 40 feet (12 meters) in height, with blast provided by a water-powered blowing engine featuring a 36-foot (11-meter) diameter all-iron waterwheel. The West Point Foundry Association operated its Cold Spring blast furnace until June 1844, when it returned to other sources of less expensive pig iron (Blake 1849). One of these was an offsite charcoal-fired blast furnace located in nearby Orange County, New York. Known as the *Greenwood Furnace*, the furnace was purchased by Gouverneur and William Kemble in 1827 and operated until 1871; the success of this furnace spurred the construction of the nearby Greenwood No. 2

furnace in 1854, an anthracite-fired blast furnace that supplied the Foundry with much of its pig iron through the Civil War (Ransom 1966:140–150).

The success of the Foundry, and the expansion that followed, greatly affected the small, neighboring community of Cold Spring, which had been little more than a small river landing settlement prior to 1818. As the Foundry's population of workers grew through the 1820s and 1830s, the community of Cold Spring grew as well. In 1846, the state of New York recognized the community's growth when it granted incorporation to Cold Spring as a Village. The municipal designation is retained to this day. At present, much of Cold Spring's domestic and commercial architecture dating from the nineteenth century is within the *Cold Spring Historic District* that adjoins the West Point Foundry Archeological Site (Barry 1982).

The West Point Foundry Association built and acquired numerous single-family homes and at least one boarding house for its workers and managers (Norris 2009). Many of these homes were set within Cold Spring, [redacted] designed by William Young, the Foundry's first superintendent (Norris 2009) (Maps 4 and 5; Figure 4). A manager's residence, later dubbed the "East Bank House" for archeological research, [redacted] during its first decade of operation; the East Bank House would later be converted into a boarding house for workers (Deegan 2006).

The Foundry's workforce averaged approximately 400 workers at any time, with a peak of about 1,000 workers at the height of the Civil War. As the Foundry and its workforce grew, Cold Spring evolved into an industrial community, with Kemble frequently providing leadership. By 1826, he had built a two-story frame dwelling, *Marshmoor*, near the Foundry, where he frequently entertained professors and officers from West Point (Gouverneur 1911:123-124; Kemble 1916). Kemble took great pride in the community his Foundry supported. He helped establish churches, schools, and served as superintendent of schools at various times. In addition to public schools, about 1830, the Association established a school for educating the Foundry's apprentices (Rutsch et al. 1979).

The West Point Foundry Association continued to secure federal contracts from the 1820s to the 1850s for a variety of cannon and projectiles, including 26 out of approximately 84 contracts let by the Navy between 1816 and 1860 (Tucker 1989:272–281). Initial production consisted of smooth bore cast-iron ordnance for newly built naval vessels in the 1820s, including the 74-gun frigates USS *Ohio* and USS *Delaware* (Tucker 1989:65). By 1860, the West Point Foundry was manufacturing cannon designed by Thomas J. Rodman and John A. Dahlgren, respectively two of the most important ordnance designers of the Army and Navy of the nineteenth century. In 1859, the West Point Foundry completed two XI-inch caliber Dahlgren guns that were later fitted aboard the USS *Monitor* (Walton 2009a:11) (Figures 5, 6a, and 6b).[11]

The federal contracts were not limited to weaponry. The Foundry also manufactured naval steam engines and boilers, dry dock pumping equipment, and at least one iron-hulled vessel during this period. Prominent projects included the manufacture of steam engines, boilers, and hardware for the steam sidewheel frigate USS *Missouri*, commissioned in 1841 (Grace and Forlow 2014:22). The USS *Missouri* was one of the first two ocean-going steam sidewheel frigates put into service with the Navy and the first to cross the Atlantic Ocean. The West Point Foundry also completed construction of the federal government's first iron-hulled vessel, the Revenue Cutter *Spencer*, fitted out in Cold Spring in 1844.

[11] The bore diameters of Dahlgren guns were typically denoted in Roman numerals in publications in the nineteenth century.

Production at the West Point Foundry for civilian markets varied greatly with steam engines, mill machinery, gears and fittings, and architectural cast-iron complementing federal contracts. The most notable civilian market products manufactured by West Point Foundry included 11 of the first railroad locomotives built in the United States in the 1830s (White 1979).

In late 1836, Kemble hired Robert Parker Parrott (1804–1877) to serve as the Foundry's superintendent (Figure 7). An 1824 graduate of the United States Military Academy at West Point, Robert Parrott had served as an artillery instructor at West Point and as second lieutenant of the Third Regiment of Artillery, participating in campaigns against the Creek and Seminole tribes in the southeastern United States in 1835 (Birkhimer 1896:332–334). After becoming the Foundry's superintendent, Parrott married Kemble's younger sister, Mary, in 1839.

When the original West Point Foundry Association agreement expired in 1843, Kemble purchased all remaining shares in the Foundry, making him sole proprietor. He also appointed Parrott Vice President that same year, and when Kemble retired from direct management in 1857, Parrott assumed control of the operation as sole lessee. Like Kemble, Parrott took an active interest in Cold Spring, serving as school superintendent and warden of St. Mary's Episcopal Church. He contributed to the erection of other churches in the community and paid taxes for widows of slain Union soldiers.

As superintendent of the West Point Foundry from 1836 to 1867, Parrott was responsible for fulfilling contracts for ordnance with the Army and the Navy. Just prior to the outbreak of the conflict, Parrott developed a rifled ordnance design that is arguably the most important contribution of the West Point Foundry to the outcome of the Civil War.

Manufacturing the Parrott Gun at the West Point Foundry

In 1860, the West Point Foundry manufactured its first Parrott gun, with Robert Parrott receiving a patent for its design the following year (Tucker 1989:70; Walton 2009a:13, see endnote 1). Incorporating a number of technical innovations in the design and construction methods of ordnance yielded a relatively inexpensive weapon often credited with changing the direction of the Civil War and even ushering in the strategies and conditions of a new era of modern warfare (Gillmore 1862; Grossman 1994, Hazlett 1983:109, Manucy 1949:16). Parrott did not supply a name for his design, but it soon became known as the *Parrott rifle* or simply the *Parrott gun*, to members of the military and public alike. The basic design of his ordnance could be scaled in size through bore diameter or *caliber*, from a relatively mobile 10-pounder field artillery model with a 2.9-inch (7.4-centimeter) (and later 3.0-inch/7.6-centimeter after 1863) caliber that weighed 890 pounds (404 kilograms) to fixed 200- and 300-pounder fortification and siege models with 8- and 10-inch caliber, each weighing several tons. As Robert Parrott alone held the initial and subsequent patents to his design, all licensed Parrott guns were manufactured exclusively at the West Point Foundry during the Civil War, though Confederate ordnance makers made similar models (Hazlett et al. 2004; Holley 1865:50; Ripley 1970; Rutsch et al. 1979).

Parrott was likely inspired by the achievements of contemporary ordnance makers, including American and British designers (Olmstead et al. 1997:111; Tucker 1989; Walton 2016). Parrott manufactured his cannons at the West Point Foundry with three innovations recently introduced in ordnance manufacture: (1) bore rifling; (2) built-up breech reinforcement with a welded wrought-iron band; and (3) for larger caliber guns (those of 8- and 10-inch [20.3- and 25.4-centimeter] caliber), the use of a water circulating apparatus to aid the gradually cooling of a gun casting while in the mold (Hazlett et al. 2004; Olmstead et al. 1997; Trepal 2008a; Walton 2016) (Figure 8).[12]

Most of all, however, Parrott designed his eponymous cannons with the advantages of rifling in mind. Although rifled small-caliber firearms had proven their usefulness in warfare long before the mid-nineteenth century, rifling of ordnance was largely not attempted before the 1840s (Manucy 1949:14). Until this period, nearly all ordnance featured a *smooth* bore, which offered a maximum range of approximately 600 yards (550 meters), but a typical effective range of less than 100 yards (91 meters) for well-aimed fire (Ripley 1970:17-18). By the mid-1850s, however, some ordnance makers, such as William Armstrong in Great Britain, successfully made rifled ordnance that demonstrated the advantages of rifling over their smoothbore counterparts (Bastable 1992:213-247; Holley 1865). Rifling, long, helical grooves cut along the length of a cannon's bore, imparted spin to a projectile after firing, increasing its effective aiming range to over a mile (1.6 kilometers) (Figure 9). Consequently, an opponent who could field such weapons possessed advantages over an adversary armed with smoothbore cannon alone.

Each Parrott gun, regardless of caliber, began as a wooden pattern, made in the Foundry's pattern shop by skilled woodworkers (Figure 10). Moulders in the moulding shop used the patterns to form a cavity in a sand mold that took the shape of the cannon to be cast. Once moved to the Foundry's moulding shop, the hinged, two-part sand mold flasks were set upright into vertical casting pits, like the two depicted in the foreground of *The Gun Foundry*. Skilled founders poured molten iron from a ladle into the base of each mold through an aperture called a *gate*, with the iron rising up into and filling the open cavity. After cooling and removal from the mold, machinists set each gun casting into a lathe to machine or *turn* the exterior to expose defects or fissures rendering it unfit for service (Trepal 2008a).

All Parrott guns were, as their designer intended, *rifled*. Using powered cutting machinery, the Foundry's machinists cut alternating rows of grooves and *lands* (the raised metal between grooves) along the length of a cannon's bore. Together, the grooves and lands were called *riflings* (Holley 1865:53) (Figure 11). Upon firing a charge set in the breech at the rear of a cannon, a shell would be propelled at a high velocity through the rifled bore. As it traveled along the bore, a soft metal ring called a *sabot* (often made of brass) affixed around the base of a shell gripped or *engaged* the lands of the riflings, imparting spin to the shell as it exited the cannon's muzzle. The spiraling of the specially designed conical shells reduced air resistance, or *windage*. Thus, rifled cannons could achieve greater ranges and accuracy over smoothbore or non-rifled ordnance (Forlow, personal communication 2016; Hazlett et al. 2004).

Besides rifling, the patented reinforcement of the Parrott gun's breech set it apart from contemporary cast iron ordnance in the United States. Breech reinforcement was critical to accommodate the larger powder charges needed to fire shells from rifled ordnance (Holley 1865). By the Civil War, the suite of heavy forging tools and skilled workers in the West Point Foundry's blacksmith shop—including one powered hammer weighing seven tons (6.4 metric tonnes)—offered the ready means to make complicated forgings from wrought iron (Lesley 1859:150). This capability also allowed the Foundry to scale the size of breech bands to fit guns ranging from field ordnance to siege weapons without significant changes to Parrott's patented manufacturing process. Each breech band was fabricated from a length of wrought iron bar that was heated and wrapped around a fixed cylindrical tool called a *mandrel* to form a large coil resembling a spring (Holley 1865: 51; Tucker 1989:228-

[12] In the 1840s, Captain Thomas J. Rodman of the US Army's Ordnance Department patented a water-circulating process, sometimes referred to as the "wet chill process," to ensure progressive cooling from the interior to the exterior of large caliber ordnance castings (Rodman 1847; Olmstead et al. 1997). An apparatus for this process is visible center-right in John Ferguson Weir's painting, *The Gun Foundry* (1864-1866), which depicts the casting of cannon at the West Point Foundry near the close of the Civil War (Fahlman 1997).

229). With the coil at a welding heat, workers then compressed it length-wise with the use of a large, power-driven hammer, striking the coil with multiple blows, welding the turns of the coil together until they formed a single band of iron (Olmstead et al. 1997:111) (Figure 12).

Parrott's patent included the specifications for how to fit a band around the breech of a cast iron gun tube. First, a water-circulating apparatus set within the bore kept the gun tube at a constant temperature while the tube was rotated on its short axis; with the tube turning, a wrought iron band, heated once again, was slipped over the breech. As it cooled and shrank (with the tube continuing to rotate), the breech band tightened in a uniform manner and thereafter kept the breech in compression and capable of withstanding shocks from propellant charges larger than those typically used in smoothbore ordnance (Trepal 2008a). Parrott's water-circulating process was entirely unique to his patent and was either unknown or not applied in the manufacture of other ordnance of the period (Ripley 1970:110).

The West Point Foundry manufactured the Parrott gun in seven basic models (not including several minor variations to these different models) and were designated by the weight of a solid cast-iron shell that each model could fire: 10-, 20-, 30-, 60-, 100-, 200-, and 300-pounder models (Grace and Forlow 2014; Hazlett et al. 2004; Olmstead et al. 1997).[13] The scaling of each model was achieved through proportionally increasing the dimensions of Parrott's basic gun pattern and reinforcement breech band and ensuring the use of pig iron that was well-suited for large, thick cross-section castings that had to withstand repeated shock (Holley 1865:53). Parrott also designed and manufactured the projectiles at the West Point Foundry, for each model with a wide variation in the shells, such as those intended for use against infantry, fortifications, or vessels.

Through Parrott's leadership, the extensive physical plant of the West Point Foundry, and pools of skilled workers drawn to Cold Spring, the West Point Foundry could produce 25 Parrott guns and 7,000 projectiles per week by the end of 1861, exceeding the capacity to produce a wide variety of armaments of all its major competitors on either side of the conflict (*Harper's Weekly* 1861:580). The Foundry's high production capacity stemmed from its investment in its extensive moulding shop, boring mill, and machine shop layout and the skilled labor that the West Point Foundry Association retained through receiving regular ordnance contracts over the previous three decades (Tucker 1989:272–281).

As the Civil War progressed, and both the Army's and the Navy's experience with Parrott guns grew, Parrott modified his earlier designs, expanding the caliber of the original 10-pounder model from 2.9 inches to 3 inches (the latter model designated as the "M1863") to accommodate the projectiles of other field artillery in service, such as the all wrought-iron 3-Inch Ordnance Rifle (Hazlett et al. 2004). This modification allowed projectiles to be used between different types of ordnance produced by competing makers, helping solve a problem that plagued artillerymen in several of the war's earlier battles (Ripley 1970). Parrott also developed a breech-loading variant of the 60-pounder model for use aboard naval vessels but its service record is not well known.

<u>The Decline and Abandonment of the West Point Foundry, 1867–1911</u>

In 1867, Parrott relinquished his lease of the West Point Foundry to four of Gouverneur Kemble's nephews (Gouverneur Kemble never married or had children of his own; Robert Parrott also did not have any children with his wife, Mary). Gouverneur Paulding and James N. Paulding (sons of James Kirke and Gertrude Paulding) and Peter Kemble and Gouverneur Kemble, Jr. (sons of William Kemble) formed the firm of *Paulding, Kemble & Company* to lease and operate the West Point Foundry (Rutsch et al. 1979:116). Robert

[13] The 150- and 200-pounder Parrott gun models were essentially of the same design (both sharing an 8-inch caliber), with the 150-pounder model having a slightly shorter barrel to accommodate service aboard naval vessels (Grace and Forlow 2014).

Parrott, taking ownership of the Foundry from Gouverneur Kemble in 1870, bequeathed the property entirely to Paulding, Kemble & Company upon his death in 1877 (Rutsch et al. 1979). In the years that followed 1867, however, federal contracts for ordnance rapidly declined as steel eclipsed cast and wrought iron as the preferred metal for ordnance (Gordon 1996:218). Advances in steel manufacturing made its use not only cost effective, but steel performed considerably better than cast iron or even wrought iron. The West Point Foundry sold a limited number of cast-iron munitions to foreign governments in the 1870s and 1880s, but this source of revenue never equaled the Foundry's earlier ordnance contracts (Rutsch et al. 1979). To maintain viability, the West Point Foundry shifted its attention more squarely to markets for heavy capital equipment in the 1870s, such as blowing engines for blast furnaces and sugar-making equipment for the Caribbean market. Unfortunately for Paulding, Kemble & Company, the economic recession following the Panic of 1873 likely reduced their volume of machinery business to less than what was needed to offset losses in ordnance contracts (Rutsch et al. 1979). Also in the same decade, newer, more specialized heavy capital equipment makers began to appear in the Middle Atlantic and Mid-West states, gaining increasing shares of national markets that the West Point Foundry had prospered in before the Civil War (Hunter 1979; Meyer 2006).

The Foundry operated under the leadership of Paulding, Kemble & Company for approximately 20 years until ca. 1887. Unable to maintain longer term success or secure new ordnance contracts, the company relinquished ownership of the property in the late 1880s.[14] Following a decade of diminished operation, the West Point Foundry was purchased in 1898 by the structural ironwork firm of J.B. and J.M. Cornell (Gorka 2013:158). The Cornells' firm carried on work at the Foundry until about 1911 before succumbing to bankruptcy that partly stemmed from the economic downturn following the Panic of 1907. During the brief period of operation under the Cornells, the Foundry expanded with the addition of a bridge shop for fabricating pre-constructed bridge components and a japanning shop for lacquering products such as outdoor cast iron furniture made at the Foundry. The firm continued to produce a variety of cast-iron goods and machinery, including assembly of a limited number of steel-barreled, breech-loading seacoast guns and components for the Pennsylvania Railroad's North River Tunnels, the first railroad tunnels built beneath the Hudson River (Rutsch et al. 1979).

When the Cornells' firm consolidated their business interests in New York City in 1911 under the new "Cornell Iron Works" name, any remaining valuable equipment and machine tools of the West Point Foundry were likely sold under the terms of the bankruptcy. Following its closure, the Foundry property passed through a series of successive owners, none of whom took steps to greatly repurpose or redevelop the property for industrial uses, leaving its vacant buildings to succumb to salvage and decay.

Criterion 1: Shaping the Political Landscape, Military Institutions and Activities and Developing the American Economy, Extraction and Production

The West Point Foundry and the Civil War

The West Point Foundry Archeological Site is the most intact and accessible site of a major Civil War-era ordnance maker. As the site where the Parrott gun was developed and manufactured, the Foundry is the site wherein the greatest share of the most advanced heavy ordnance utilized in the war was designed and/or manufactured. Of the 8,000 field, siege, fortification, and naval ordnance produced in the Northern states during the war, the West Point Foundry accounted for nearly 1,700 Parrott guns in service with the Army (925 pieces

[14] In 1887, the Washington Navy Yard assumed responsibility as the primary supplier of steel guns for the Navy, while that same year, the Army's Watervliet Arsenal north of Albany, New York, took responsibility for producing new, all-steel heavy ordnance entering service with seacoast and field artillery units (Adams and Christian 1975; Misa 1995:96-98; Swanteck 2009). Consequently, none of the major antebellum ordnance makers secured new contracts, while the large forgings for making steel guns were produced by an emerging group of specialized private steel producers, dominated by the Bethlehem Steel Company in Pennsylvania by 1890.

for field artillery and 759 pieces for siege and seacoast service) and approximately 1,000 guns for the Navy (Holzer 2002; Tyrrell 1962:8).[15] These figures contrast with those of the Foundry's major competitors in the Union: the South Boston Iron Company and the Fort Pitt Foundry, which produced 755 and 942 pieces of field artillery, respectively, and the Phoenix Iron Works of Phoenixville, Pennsylvania, which produced at least 866 pieces of the wrought-iron 3-inch Ordnance rifle (Hazlett et al. 2004; Olmstead et al. 1997:112, see footnote 10, p. 121; Ripley 1970; Tyrrell 1962:7). In comparison, total production at the Tredegar Iron Works, the largest Confederate ordnance maker, amounted to approximately 1,100 pieces or roughly half of total ordnance production in the South during the Civil War (Dew 1999).

Based on these figures, the West Point Foundry manufactured one in every three pieces of ordnance in service with Union field artillery and siege units as well as one in five guns mounted on warships (Olmstead et al. 1997:112, see footnote 10, p. 121; Trepal 2008a; Tucker 1989:230). But total production aside, Robert Parrott's patented rifled ordnance was the most important and recognizable contribution of the West Point Foundry to ordnance deployed during the war (Ripley 1970; Tucker 1989). With combined improvements in accuracy, range and striking power over traditional smooth-bore armaments, the widespread introduction of rifled cannon into military operations ushered in a new era of warfare which rendered traditional mortared fortifications obsolete (Gilmore 1862, Grossman 1994, Hazlett 1983:109, Manucy 1949:16).

Robert Parrott reportedly considered the supply of weapons to Union forces a patriotic duty, and so he offered them to the government while securing only a modest profit (Hazlett et al 1983:109). To a certain extent, the success of the Parrott gun can be owed to the fact that the Foundry could construct them rapidly and sell them relatively cheaply for immediate military service. The volume of Parrott guns made by the West Point Foundry greatly increased the overall number of ordnance in service with Union field artillery units and naval vessels while providing advantages in range and accuracy over opposing Confederate forces. The unique service of the Parrott gun for Union forces underscores the national significance of the West Point Foundry to American military and political history. Parrott guns were deployed in three settings over the course of the Civil War: in siege operations, in field operations with artillery units, and aboard naval vessels (Hazlett et al. 2004; Holley 1865; Olmstead et al. 1997; Ripley 1970).

<u>The Parrott Gun in Siege Operations</u>

The largest of the Parrott guns, the 30-, 100-, 200- and 300-pounder models, saw service primarily in siege and seacoast operations against Confederate-held fortifications and on occasion, populated areas (Olmstead et al. 1997) (Figures 15 and 16). Among the first and most demonstrative episodes of its early deployment came in April 1862 when Union forces deployed 30-pounder Parrott guns to successfully breach a corner of Fort Pulaski outside of Savannah, Georgia.

The fort, a brick-clad Third System fortification, had 7.5-foot (2.3-meter) thick walls and served as the principal defense for Savannah's harbor. The nearest land whereupon Union forces could set up a battery was the low, marshy Tybee Island. At nearly one mile away, it was believed to be too far outside the effective range of traditional siege weapons. Before the onset of hostilities, General Lee reassured the commanding officer of the fort, Colonel Charles Olmstead, that though Union shelling "will make it very warm for you…they cannot breach at that distance." At the time, reference sources suggested that 800 to 900 yards were the extreme range at which a wall of masonry could be successfully penetrated by siege weapons (Olmstead 1917:102). Forces under commanding officer General Quincy Gillmore, however, proceeded with the creation of a series of

[15] These figures do not include mortar artillery pieces that were produced in large quantities by major and several smaller ordnance makers before and during the Civil War.

hidden batteries equipped with a combination of smoothbore mortars, Colombiads, and rifled Parrott and James guns (Gillmore 1862:24). Ultimately, the rifled weapons took less than a day and a half to breach the defenses of Fort Pulaski, resulting in the surrender of the fort's garrison (Gillmore 1862; Hazlett et al. 2004; Lattimore 1954:36). This result surprised even the Union forces. Reflecting upon the laborious construction of the batteries over marshy land, General Gillmore concluded that the rifled weaponry so far outperformed the smoothbore mortars and cannon in accuracy and penetration that he could have saved seven of the eight weeks of preparation had he limited his armaments to rifled weapons (Gilmore 1862:51).[16]

News of the unexpectedly successful application of rifled ordnance spread. Two months later President Abraham Lincoln paid a visit to the West Point Foundry to observe the construction and operation of Parrott guns, with the victory at Fort Pulaski fresh on his mind. This visit, in turn, led to their widespread adoption by Union forces. A year later, Gillmore famously used Parrott rifles to attack Charleston's defenses, reducing Fort Sumpter and Battery Wagner to rubble from some 2 miles away (Manucy 1949:20). In a letter sent by the Confederate commander of Battery Wagner, Colonel Keitt, just before he surrendered the post in September 1863, he stated, "The garrison must be taken away immediately after dark, or it will be destroyed or captured. It is idle to deny that the heavy Parrott shells have breached the walls and are knocking away the bomb-proofs" (United States War Department 1890:103). Of all examples of the effectiveness of Parrott guns, newspaper reporters focused the most attention on a 200-pounder Parrott gun mounted in a fortification outside of Charleston in 1863. Dubbed the "Swamp Angel," the cannon successfully fired 35 incendiary rounds into the city, but burst upon firing the thirty-sixth round, shortening its barrel (Hazlett et al. 2004). Similar instances of larger model Parrott guns bursting, as well some smaller caliber models, occurred over the course of the conflict. These occurrences led to a Congressional inquiry in 1865, where Robert Parrott himself testified in defense of his patented ordnance, claiming that errors by gun crews or poor conditions (e.g., sand lodged between shells and gun bores) were to blame for many of the instances of explosive rounds prematurely detonating before exiting the muzzle (Grace and Forlow 2014; Olmstead et al. 1997; Parrott 1865). Despite his reassurances, though, examples of bursting Parrott guns caused many Army and some Navy officers to doubt their continued use after the war.

The Parrott Gun in Field Artillery Service

Union field artillery units typically deployed the 10-pounder Parrott gun in field engagements, including the battles of First Bull Run in 1861, Antietam in 1862, and Gettysburg in 1863, as they were relatively maneuverable in moderate terrain and required modest-sized crews to operate (typically eight in number); the 20-pounder model saw field service as well but generally in more fixed positions due to its doubled weight. The West Point Foundry produced the 10- and 20-pounder Parrott guns in quantities nearly matching those for the bronze smoothbore Model 1857 Napoleon 12-pounder and the wrought-iron 3-inch Ordnance Rifle that were made by other gun foundries (Hazlett et al. 2004) (Figure 13).

Field artillery units preferred to deploy the Model 1857 (or *M1857*) Napoleon 12-pounder and the 3-inch Ordnance Rifle with direct fire against infantry units, while focusing their 10- and 20-pounder Parrott guns on counter-battery fire (i.e., fire against opposing artillery batteries) (Hazlett et al. 2004). In this capacity, the Parrott field models offered superior range of fire and overall accuracy, advantages compounded by the greater number of pieces available to Union field artillery (Ripley 1970; Tyrrell 1962).

[16] The site of Fort Pulaski is now maintained by the National Park Service as a national monument principally interpreted as significant for its representation of an earlier era of mortared coastal fortifications, ending with the bombardment by rifled ordnance in April of 1862 (National Park Service 2003:10).

For Union gunners at Gettysburg, the 10-pound Parrott model comprised approximately one-sixth of the artillery fielded in the battle by the Army of the Potomac and proved especially effective in assaulting Confederate artillery batteries, wreaking havoc on ammunition resupply, and reducing their effectiveness in firing on Union infantry positions (Gilmore 1989:5-6). Parrott guns were also used directly against infantry advances: from nearly a mile (1.6 kilometers) distant, the six 10-pounder Parrott guns of Battery D of the 5th US Regiment of Artillery positioned on Little Round Top fired into the southern flank of Pickett's Charge on July 3, 1863 (Hall 2003:314).

The advantages of the Parrott gun were not exclusive to one side in the conflict; Confederate forces captured roughly 75 10- and 20-pounder model Parrott guns produced by the West Point Foundry over the course of the war and incorporated them into their own field artillery units and tactics, including the use of at least 40 West Point Foundry-made Parrott 10-pounders at Gettysburg (Cole 2002; Ripley 1970). Interestingly, Parrott's designs impressed Confederate artillery commanders and ordnance makers in the South during the conflict, notably the Tredegar Iron Works in Richmond, produced several *Confederate Parrott* guns that were close but distinguishable copies of the 10- and 20-pounder models for service in the field and aboard naval vessels (Hazlett et al. 2004:111).

<u>The Parrott Gun in Naval Service</u>

Parrott guns, including the 20-, 30-, 60-, 100-, and 150-pounder models, were mounted aboard several naval vessels and differed in minor details from their land-based counterparts to meet the needs of service at sea (Grace and Forlow 2014; Olmstead et al. 1997; Tucker 1989) (Figure 14). One commenter in the Navy observed early in the war that "[e]ver since the first appearance of the [Parrott] gun, and the first experiments made with it, it has been growing in favor, and it bids fair now to supplant all previous inventions in the line of rifled cannon" (Simpson 1862:423-424, quoted in Tucker 1989:232). By the beginning of 1864, approximately 20 percent of all guns in service with the U.S. Navy were Parrott models and by the close of the war, they had become a "favorite gun in the Navy" (Tucker 1989:230). In contrast to large-caliber smoothbore guns that were preferred for close quarter (approximately 1,000 yards/914 meters or less) ship-to-ship fire, such as those designed by Admiral John A. Dahlgren, the Parrott gun provided naval gunners an ability to reach targets up to 5 miles (8 kilometers) distant, or more effectively penetrate harbor fortifications and shore batteries, such as Forts Sumter and Wagner in South Carolina (Tucker 1989:230).

Parrott guns were fitted on to conventional naval truck carriages as well as pivoting carriages. For example, the steam screw frigate USS *Wabash* mounted a 150-pounder Parrott gun on a pivoting carriage set at the vessel's bow that allowed it to turn the gun from side to side and aim at targets forward of the vessel (Grace and Forlow 2014). The 100- and 150-pound models were also featured aboard ironclad frigates, including USS *Galena*, USS *New Ironsides*, and USS *Roanoke*, and in the turrets of ocean-going monitor warships, including USS *Roanoke*, USS *Onondaga*, and USS *Tunxis* (Konstam 2002:40-42).

<u>The Public and Political Image of the Parrott Gun</u>

The outsized contributions of the West Point Foundry in the Civil War prompted one period commentator to quip that "our national bird should be the parrot instead of the eagle" (Paulding 1879). The West Point Foundry's prominence in ordnance manufacture during the war drew the attention of national press outlets, such as *Harper's Weekly* and *Frank Leslie's Illustrated Newspaper*, and President Abraham Lincoln himself, when he visited the Foundry on the afternoon of June 24, 1862, following a meeting with General Winfield Scott at West Point earlier that morning (*Frank Leslie's Illustrated Newspaper* 1862; Gary 2002:273; *Harper's Weekly* 1861). As Harold Holzer summarized in his account of New York State's contributions to the war, "Lincoln could not have departed the West Point area without the conviction that sophisticated, accurate relentless weaponry would yet become the key to Union victory" (2002:9). Holzer's observation is well-grounded since the siege and recapture of Fort Pulaski in April of that year was undertaken by Union assault forces with the prominent use of Parrott guns, a detail likely fresh in the President's mind that summer.

Many Parrott guns and other ordnance produced by the West Point Foundry survive to the present, including several examples of the 10- and 20-pounder Parrott gun models. These can be found on display in public parks throughout the country, including most Civil War-associated National Park Service units. Owing to the bulky wrought-iron reinforcement at the weapon's breech, they are easily recognizable. As such, in the public's imagination they play a prominent role as iconic of the heavy artillery used during the war.

<u>American Industrialization and the West Point Foundry</u>

The West Point Foundry Archeology Site is significant for the variety of goods it produced other than the armaments manufacture for which it is renowned. Major American foundry and ironworking industries between 1815 and 1865 were critical to the transformation of the American economy with the expansion of technological developments in the manufacture of capital goods and, to a lesser extent, ordnance, which acted as catalysts in that transformation. American politicians of the late eighteenth and early-nineteenth century recognized that the development of independent domestic industrial manufacturing amounted to "a second war for independence from Britain" (Cochran 1981:76–77). The production of innovative capital goods, such as those produced by the West Point Foundry, is crucial to the successful growth of all other industries for developing industrial economies (Habakkuk 1962, Rosenberg 1963). The integrated works of the West Point Foundry were responsible for the design, production and proliferation of a variety of heavy machinery integral to catalyzing industrial growth in realms as diverse as transportation, architecture, armaments, and manufacturing. With markets supplied by heavy industry—whether for ordnance or marine steam engines—expanding and contracting in often erratic ways in the antebellum period, the ability of the West Point Foundry to adjust to depressed demands for military and capital goods permitted continuity in its manufacturing capacity and the retention of skilled workers (Pursell 1969:102). Consequently, the technological systems of the West Point Foundry and its skillful management reinforced the sometimes unstable expansion of the antebellum national economy as well as its defense.

The site is one of the most intact representations of these diversified ironworking sites pivotal to American industrialization before the Civil War. Two key aspects of the Foundry's layout and operations facilitated its capacity to adaptably fulfill demand for specialized heavy capital equipment for a number of economic sectors key to early American industrial growth. Its integrated layout, including the unique exploitation of a local waterpower source and integrated iron production, endowed its capacity to flexibly and efficiently concentrate various stages of production on a single site. The adaptation of waterpower resources by the designers of the Foundry—resources that period competitors increasingly disregarded in favor of steam power—increases the unique significance of the West Point Foundry Archeological Site as an example of a leading ironworking enterprise adhering to a power-generation strategy dependent on local landscape resources. Componential to this integration is the Foundry's concentration of a variety of skilled workers. Fundamental to the West Point Foundry's success were the five sets of skilled workers it attracted or trained: foundry pattern-makers, moulders, founders, machinists, and blacksmiths. Their shared knowledge of metallurgy, engineering, mechanics and fabrication boosted the Firm's capacity to innovatively fulfill industry demand for completed machinery and steam engines from more specialized, consumer-oriented industries, such as textile manufacturing and ironmaking blast furnaces, without the need to specialize in any one line of goods.[17] Putting to use the technologies of the Foundry, their work completed a labor process through which both ordnance and heavy capital equipment was manufactured (see Fracchia and Roller 2014:14).

The West Point Foundry is notable for its unique power and commodity supply strategies, which also played a role in its success. Most major foundry and ironworking enterprises in the Northeast and Middle Atlantic, situated in urban areas, relied on generating power with steam engines built into their layouts, fueled with mineral coal. And instead of operating their own on-site blast furnaces, forges, and puddling furnaces, they purchased semi-finished commodities, such as pig and wrought iron, from local wholesale dealers. The West Point Foundry Association on the other hand chose to develop an extensive waterpower system built into its layout while consuming pig iron from its own blast furnaces in the region; one such blast furnace operated within the Foundry layout from 1827 to 1844, a remarkable strategy for a major ironworking enterprise of the antebellum period (Rutsch et al. 1979).

Two notable studies on early American steam-engine makers help frame the Foundry's importance to the process of industrialization. In *Steam Power*, the second volume of Louis C. Hunter's three-volume work, *A History of Industrial Power in the United States, 1780–1930*, the author concisely traces the intertwined evolution of American foundries and ironworking technologies (particularly the machining, boring, and forging of cast and wrought iron) in the early to mid-nineteenth century (Hunter 1985:183–215). Hunter shows through numerous period accounts, statistical records, and illustrations how large American foundries and ironworking firms, such as the West Point Foundry, remained successful in the production of a diverse array of heavy capital equipment prior to the Civil War.

The West Point Foundry's ability to address the needs of several industries within a single industrial layout allowed it to remain competitive until the 1870s, when specialized makers of heavy capital equipment matured and began to capture increasing shares of industrial output. Before the 1860s, however, the West Point Foundry belonged to this distinct set of American ironworking firms, as Hunter neatly summarizes:

> Such [enterprises] produced the heaviest industrial machinery of the period, including engines of the largest class required to meet the needs of steam navigation and heavy industry. They possessed the most advanced techniques, and with a few exceptions, the only really adequate equipment for precision metalworking (1985:242).

In *Networked Machinists*, David Meyer broadens historical understanding of the major American industrial enterprises that reinforced emerging markets for heavy capital equipment. Meyer's work is a careful study of the growth and interconnected nature of early American machine shop practice, skilled machinists, and the ironworking firms they established before the American Civil War (2006). Commenting on the role of large foundries in the maturing steam engine market of the 1820s, Meyer writes that "[t]he greatest firms typically combined diversified iron foundry work with steam engine building because the demand for engines remained small" (2006:45).

Meyer goes on to demonstrate that the most prosperous foundries and machine shops in the antebellum Northeast and Middle Atlantic, in which he lists the West Point Foundry as a prominent member, were nested in linear and connected river valleys of industrial activity. Other prominent ironworking enterprises of this period included the Allaire Iron Foundry and Novelty Works in New York City, Levi Morris and Company and

[17] A *machine tool* is a powered machine, such as a lathe, drill press, or milling machine, that is used by a skilled or semi-skilled worker to shape metal or other materials (Hounshell 1984; Rolt 1986).

Merrick and Towne in Philadelphia, and in New England, the South Boston Iron Company of Cyrus Alger and Amoskeag Manufacturing Company in Manchester, New Hampshire (Meyer 2006:114-117, 166–167). They attracted skilled tradesmen that would in turn freely communicate with other skilled tradesmen at nearby firms, exchanging the latest developments and knowledge in ironworking and machining technologies (Meyer 2006). Through these exchanges, a cluster of enterprises could form concentrations or *hubs* of knowledge and practice, sometimes focused on a particularly skilled machinist or machine shop that possessed an elevated reputation between ironworking enterprises.

Networks of ironworking enterprises were further connected across regions and river valleys that afforded considerable waterpower potential, such as the Blackstone River Valley in eastern Massachusetts and Rhode Island, the Connecticut River Valley in western Massachusetts and Connecticut, the Hudson River Valley of New York, and the Delaware River Valley of Pennsylvania and New Jersey (Hunter 1985; Gordon and Malone 1994; Meyer 2006). Ross Thomson expanded on Meyer's research and approach by focusing more squarely on primary sources such as patents, business directories, and census data to trace the development and diffusion of machinist networks between 1790 and 1865 (Thomson 2009). Thomson concluded his study by noting that the West Point Foundry and other major antebellum ordnance manufacturers greatly benefited from maturing machinist networks, but did not address how such firms in turn reinforced those very networks as clearly as David Meyer accomplished in his study of the same industries (2009:306).

The West Point Foundry attracted or cultivated several skilled workers and designers that contributed to the knowledge and practice networks that Meyer traced in his research. These included William Young, the first superintendent of the Foundry, who emigrated from Ireland at the urging of Gouverneur Kemble; David Matthew and Adam Hall, who together supervised the construction of the first railroad locomotives produced by the Foundry as well as several marine steam engines in the 1830s; and Charles W. Copeland, who continued Hall's work on marine steam engines at the Foundry between 1836 and 1839. After departing from the West Point Foundry, Copeland took on the position of Constructing Engineer with the U.S. Navy, where he oversaw the fitting of a West Point Foundry-made steam engine into the oceangoing sidewheel frigate USS *Missouri* (*American Engineer and Railroad Journal* 1895; Pursell 1969; Rutsch et al. 1979; White 1979).

Although he does not appear to have served in a skilled position at the Foundry, James Renwick, Sr., an early American authority on the construction of steam engines and boilers, was a contributing member to the establishment of the West Point Foundry Association in 1818, two years before he accepted an offer to teach at Columbia College (Hunter 1985:322; Pursell 1969:127). His presence at the outset of the West Point Foundry likely bolstered the firm's ability to attract skilled foundry and ironworking talent, especially those with experience in making steam engines.

<u>"All Sorts of Manufacturing Machinery": The National Reach of the West Point Foundry</u>

Although its prolific output does not set the West Point Foundry apart from its manufacturing peers of the period, the scope of goods and markets it reached does clearly demonstrate, as Louis Hunter described, the far-reaching outlook and aggressive business strategy of the largest class of ironworking enterprises of the antebellum period (1985:242). Highlighting the Foundry's breadth of production further demonstrates its national recognition and importance to American industrialization in the early to mid-nineteenth century.

The civilian market outlook for the Foundry's first leaders, notably Gouverneur and William Kemble, is not well understood, as little of their personal writings have been discovered to date (Gouverneur Kemble's likely diary of 1817 being a notable exception; see Walton 2009b and 2009c). But two sources—an article featured in the Washington, DC, news circular the *Daily National Intelligencer* in June 1819 and a broadside advertisement of the West Point Foundry from 1821—suggest that the Foundry's leadership and skilled workers had succeeded in making iron, bronze, and brass castings for mills and "all sorts of manufacturing machinery" within two years of breaking ground in Cold Spring (*Daily National Intelligencer* 1819; Anonymous 1821). These sources should be regarded with some caution as they may have served to promote the Foundry's capabilities instead of presenting an accurate tally of its products at that time.

Yet a broad line of heavy capital equipment would not be surprising since the pattern-making and moulding shops of the Foundry supported by the water-powered boring mill could be adapted to manufacture many of the cast-iron goods and machine assemblies in demand at that time (Thomson 2009:306). Regardless of early positioning, by the 1830s, the West Point Foundry was a nationally recognized manufacturer of heavy capital equipment, as it continued to fulfill federal contracts for ordnance (Barber and Howe 1842; Blake 1849; Hazlett et al. 2004; Walton 2009a; Wilson 1886). With the addition of a machine shop in about 1839, the West Point Foundry became a complete ironworking enterprise of the period (Blake 1849: 240-241; Rutsch et al. 1979).

The Foundry made its most noted contribution to industrialization in 1830 when it completed the first American-built railroad steam locomotive, the *Best Friend of Charleston*, for the South Carolina Canal and Rail Road Company (Figure 17). This engine was built with a *0-4-0* wheel arrangement for use on a five-foot (152.4-centimeter) gauge track (Rutsch et al. 1979; White 1979). [18] The West Point Foundry built 10 more locomotives over the next five years, including the *DeWitt Clinton* for the Mohawk and Hudson Railroad in Albany, New York, and the *Experiment*, for the same railroad, that featured a revolutionary 4-2-0 wheel arrangement designed by John B. Jervis (1795-1885), chief engineer of the Delaware and Hudson Canal (Grace and Forlow 2014; Koeppel 2000; White 1979:33-34).

Jervis, one of the most distinguished American civil engineers of the nineteenth century, also served as the chief engineer of the first Croton Aqueduct after finishing the Delaware and Hudson Canal. Completed in 1842 and designed to channel fresh water from the Croton River to lower Manhattan, 40 miles (64 kilometers) to the south, the Croton Aqueduct used 2,750 tons (2,495 metric tonnes) of 36-inch (91-centimeter) diameter cast-iron pipe manufactured by the West Point Foundry (Koeppel 2000).[19] Following a major cholera epidemic in 1832 and the Great Fire of 1835, the first Croton Aqueduct was instrumental in helping New York City meet its growing needs for fresh water and fire safety.

The West Point Foundry's departure from railroad locomotive manufacturing may be explained by the national economic downturn following the Panic of 1837, which considerably slowed the growth of railroad investment and construction throughout the nation for several years (Roberts 2012; Sellers 1991). In the wake of the economic crisis, the Foundry's leadership closed its Beach Street Shops in Manhattan in 1839 where it had assembled its earlier locomotives, including the *Best Friend of Charleston,* relocating its skilled workers to Cold Spring. It is possible that Robert Parrott may have also lacked interest in competing in the locomotive market after he became superintendent of the Foundry in 1836.

If Parrott chose not to pursue locomotives, he was not alone. George Corliss, the most celebrated American stationary steam engine designer of the latter half of the nineteenth century, abandoned the manufacture of railroad locomotives in the 1850s because of the uncertainties of the new transportation industry (McHugh 1980:36). The Lowell Machine Shop of the Boston Associates produced several railroad locomotives in the 1840s and 1850s, apart from textile machinery, but did not pursue the market in the longer term and the Fort Pitt

[18] According to the Whyte notation system for classifying railroad locomotives, a "0-4-0" configuration indicates that the *Best Friend of Charleston* was constructed with no leading bogie wheels, four driving wheels, and no trailing wheels (White 1979:33).

[19] The first (or *Old*) Croton Aqueduct was designated a NHL in 1992.

Foundry in Pittsburgh also briefly manufactured railroad locomotives in the 1830s before returning to focus on ordnance and stationary and marine steam engines (Meyer 2006:165-166; Pursell 1969:102).

Despite a depressed economy extending into the mid-1840s, the West Point Foundry continued to broadly influence the capacity of the Nation's industrial growth by producing and circulating a range of heavy capital equipment. These included stationary and marine steam engines, air and water pumps for excavating railroad bridge caissons, sugar mills for the Caribbean, cotton presses for plantations across the American South, and various designs of machinery for milling flour, rice, cotton seed oil, and lumber (*American Railroad Journal* 1854:274; Barber and Howe 1841, cited in Rutsch et al. 1979; Fisher 1940:4). In 1851, the Foundry completed a stationary vertical-beam engine and water pumping machinery for the dry docks of the New York Navy Yard in Brooklyn (Grace and Forlow 2014). Adorned with Gothic-style arches, the steam engine and pumping machinery, according to one commenter, was likely one the largest assemblies of its kind in the nation at that time (Stuart 1852). Three years later, the new steam frigate USS *Merrimack* was fitted out with a steam engine produced by the West Point Foundry that would later serve the CSS *Virginia* during the Civil War (Grace and Forlow 2014).

Although the Foundry remained largely powered by vertical waterwheels, its skilled tradesmen and machinists manufactured some of the earliest American-made horizontal water turbines. In the early 1850s, the West Point Foundry completed water turbines designed by Emile Geyelin, a French engineer who had emigrated to the United States in 1849 (Hunter 1979:326). The efficiency and durability of Geyelin's turbines helped persuade skeptical American mill owners of the advantages offered by the horizontal turbine, especially its greater power generation potential and decreased maintenance costs in comparison with vertical waterwheels. The horizontal turbine would extend the usefulness of waterpower well into the twentieth century (Gordon and Malone 1994).

The West Point Foundry was also responsible for introducing cast iron as an architectural building material when it made components for the four-story Edgar Laing Stores building in lower Manhattan, completed in 1849 (Grace and Forlow 2014; Historic American Building Survey [HABS] NY-5469 1974).[20] The first structure to feature self-supporting, multi-storied cast-iron loadbearing elements, this revolutionary commercial building was designed by James Bogardus, an early proponent of adapting cast iron for American building design (Gayle and Gayle 1998). The use of cast iron became popular for the next half century as it was efficient and inexpensive to erect and, importantly, fire-resistant in an era marked by major urban conflagrations (Waite 2004:301). Moreover, the plastic ability of cast iron to replicate or fabricate diverse shapes while providing parsimonious structural support opened architecture to new organizational and aesthetic possibilities (Gayle and Gayle 1998). The West Point Foundry continued to compete in the market for commercial cast-iron architecture, largely in Manhattan, through the remainder of the nineteenth century (Rutsch et al. 1979).

With an improving national economy in the 1850s, the West Point Foundry maintained its presence in national markets for industrial machinery. In 1856, the Foundry supplied the rebuilt Cornwall Furnace in southeastern Pennsylvania with a 20-horsepower horizontal steam engine and boilers. This assembly remains intact within the Cornwall Iron Furnace site, a state historic site that is open to the public and was designated as a NHL in 1966 (American Society of Mechanical Engineers [ASME] 1985).

An outstanding surviving example of the reach and variety of the heavy capital equipment produced by West Point Foundry in the late antebellum period is a restored and operational, vertical-beam steam engine and sugar cane mill, located at the Hacienda La Esperanza Nature Reserve (Hacienda La Esperanza Para la Naturaleza) in

[20] The Edgar Laing Stores building, formerly located at the northwest corner of Washington and Murray Streets in Manhattan, underwent demolition in 1971.

the Municipality of Manatí, Puerto Rico (Figures 18 and 19). The reserve is a preserved nineteenth-century sugar plantation maintained by the Puerto Rico Conservation Trust (see Historic American Engineering Record [HAER] PR-7 1976). Completed in 1861 for one of Puerto Rico's preeminent sugar magnates of the period, José Ramon Fernández, and accented with Gothic-style ornamentation like that of the vertical-beam engine built for the New York Navy Yard a decade earlier, the engine and sugar cane mill demonstrated the West Point Foundry's contributions to the evolving economy of not only the United States, but also of other nations and their colonial economies in the Caribbean region in the nineteenth century (Meniketti 2006; Roosevelt 1976).

Criterion 6: Peopling Places, Community and Neighborhood; Expanding Science and Technology, Experimentation and Invention; Developing the American Economy, Extraction and Production, Workers and Work Culture

Previous archeological investigations of the West Point Foundry Archeological Site have yielded data illuminating antebellum foundry and ironworking organization and practices that are of unique significance to the study of American industry, labor, and economic change in the early to mid-nineteenth century. As discussed above, major American foundry and ironworking industries between 1815 and 1865 were critical to the transformation of the American economy with the expansion of technological developments in the manufacture of capital goods and to a lesser extent, ordnance, acting as catalysts in that transformation. With markets supplied by heavy industry—whether for ordnance or marine steam engines—expanding and contracting in often erratic ways in the antebellum period, the ability of the West Point Foundry to adjust to depressed demands for military and capital goods permitted continuity in its manufacturing capacity and the retention of skilled workers (Pursell 1969:102).

Consequently, the technological systems of the West Point Foundry and its skillful management reinforced the sometimes unstable expansion of the antebellum national economy as well as its defense. This technical competency has been identified in the archeological record of the site through select studies of activity areas of the Foundry. [redacted]

Studies of nineteenth-century American iron industries have largely concentrated on those involved in making semi-finished ferrous commodities at blast furnaces, forges, puddling and rolling mills, and later, steel plants (see, Gordon [1996], Gordon and Malone [1994], *IA: Journal of Society for Industrial Archeology*, Volume 18, Numbers 1 and 2 [1992], and McVarish [2008] for examples of these studies). These efforts have also included intensive background research and documentation and study of extant above-ground buildings and structures associated with ironmaking industries, conducted by the NPS's HAER since 1969. Well-executed studies undertaken by academic and professional researchers have also focused on these industries as well (Council et al. 1992; Kirby 1998; Ransom 1966; Rolando 1992).

But as clarified by prior literature searches of the West Point Foundry and its historical and technological context, large multi-faceted antebellum foundry and ironworking firms lack strong representation in the historical and archeological literature of early American industrialization (Herzberg 2005; Norris 2002; Trepal 2008a). Even a highly respected source of comprehensive history on early industrialization in America overlooks the West Point Foundry in stating that integration in iron production, "came only after 1855" (Cochran 1981:107). This absence may stem from the lack of surviving sites, poor integrity or inaccessibility of those sites that do survive in sub-surface contexts, and a lack of primary source material useful for reconstructing the origins and development of a given site. It is worth noting that the National Park Services' HAER staff have undertaken the documentation of several dozen foundry and machine shop sites that retained a high degree of architectural integrity at the time of documentation. However, these sites date almost entirely to the late nineteenth century and later and therefore are not contemporary with the period of national significance for the West Point Foundry Archeological Site.

Given this deficit in research, the results of previous archeological investigations of the West Point Foundry Archeological Site are challenging to compare and contrast, as many similar sites have lost archeological integrity through intensive demolition and redevelopment. Such sites include the contemporary gun foundries of the Fort Pitt Foundry in Pittsburgh and the South Boston Iron Company in Boston, as well as several chief heavy capital equipment makers of the period that include the Novelty Iron Works and the Allaire Iron Works, both in New York City, and in Philadelphia, the firms of I. P. Morris and Merrick & Towne (Meyer 2008). because of this deficiency, the archeological resources of the West Point Foundry Archeological Site are together a stand-alone opportunity for the archeological study of a large American multi-faceted foundry and ironworking site of the antebellum period that played a critical role in both the nation's defense and the industrialization of its economy and culture. It is also important to note that much of the written record that managers and workers of the West Point Foundry generated in the different activity areas of the Foundry is likely irretrievable, heightening the value of the archeological record of the site.[21]

Although several archeological investigations have been undertaken throughout the site since 1979, large portions of the West Point Foundry Archeological Site are undisturbed and potentially accessible for investigation. Any such investigation could more fully inform on how managers and skilled workers adapted the West Point Foundry to meet the needs of an evolving national economy undergoing transformations that could not be anticipated with certainty. There are four avenues for archeological research of the West Point Foundry that are of national significance to the study of labor and industrialization in the United States: (1) the adaptation of water and landscape resources that served a unique, multifaceted ironworking enterprise; (2) the adoption and management of diverse technologies associated with patterns of industrialization; (3) the roles of skilled and unskilled workers in the process of industrialization; and (4) the lives of workers as reflected in the material culture of domestic settings.

<u>Nationally Significant Archeological Research: Industrial Archeology and Labor Processes</u>

Industrial archeology began to take shape as a distinct discipline of study among heritage preservationists and academic researchers in Great Britain in the mid-1950s but did not attract similar attention in the United States until the 1960s (Palmer and Neaverson 1998:1, 8, 9; Rix 1955). A small number of American archeologists, though, took on studies of industrial sites by 1960. Between 1948 and 1953, Roland W. Robbins directed the excavation of the Saugus Iron Works site in Saugus, Massachusetts, the first major archeological study of an industrial site in the United States (Griswold and Linebaugh 2010).[22] Consulting historical research to guide excavations, Robbins' work demonstrated the research and interpretation value of the archeological study of buried industrial sites. The results of his work supported the reconstruction and interpretation of the site as a privately owned park opened to the public in 1954, and in 1968 the NPS acquired the property, creating the

[21] The historical background and archeological overview report of the West Point Foundry, completed by Cultural Resource Management Services in 1979 under the direction Edward Rutsch, and a master's thesis completed by Elizabeth Norris (Hartnel) in 2002 together provide exhaustive inventories of known primary sources associated with the West Point Foundry Archeological Site. Other unidentified written records may be located through future research but the results of Rutsch et al. and Norris provide the most complete accountings of known primary sources associated with the West Point Foundry.

[22] In November 1945, Roland W. Robbins gained national recognition for his discovery and excavation of foundation features associated with Henry David Thoreau's Walden Pond cabin near Concord, Massachusetts (Linebaugh 2005:27–57).

Saugus Iron Works National Historic Site (Griswold and Linebaugh 2010). Working with the NPS, early historical archeologists J. C. Harrington and John Cotter oversaw similar studies at the Hopewell Furnace site in southeastern Pennsylvania between 1949 and 1951 (Glaser 2005:119–120).

The notable work of Robbins, Harrington, and Cotter aside, the practice of industrial archeology in the United States since the 1960s has largely focused on the study of extant above-ground buildings, structures, machinery, artifacts, and infrastructure (Gordon and Malone 1994:23). This approach to industrial archeology gained federal support with the creation of the HAER program in 1969 as a joint effort between the National Park Service, the American Society of Civil Engineers, and the Library of Congress and as a counterpart to the HABS. The HAER program adopted many of the documentation techniques in use by the HABS program, including large-format photography and delineated plan, elevation, and axiometric projection drawings. A major outcome of the HAER program has been a heightened recognition by archeologists and historians of the importance of studying and preserving industrial heritage for scholarship and public appreciation (DeLony 1999:5–28).

The earliest published studies of industrial archeology were confined almost exclusively to New England and the Middle Atlantic regions, but its geographic scope expanded in the 1970s and 1980s to include sites and landscapes throughout the United States. Many of these efforts were initiated by a mix of academic and public institutions, such as the excavation of the Bluff Furnace site in Chattanooga, Tennessee, by archeologists with the University of Tennessee at Chattanooga and America's Industrial Heritage Project, a joint study of Pennsylvania industry by the NPS and public and private partners (Council et al. 1992; NPS 1987). The formation of the Society for Industrial Archeology (SIA) in 1971 provided a professional forum for exchanging and publishing research and the SIA's journal, *IA*, has been the North American publication of record for the discipline since 1975 (Hyde 1991:3–16). The growth of cultural resources management (CRM) in the United States—spurred by passages of the National Historic Preservation Act (NHPA) in 1966 and the National Environmental Protection Act (NEPA) in 1970—has expanded identification and recordation of industrial heritage but the results of these efforts remain mostly unpublished.

Since the 1990s, archeologists have increasingly included the role of labor in their studies of industrial sites and landscapes (Beaudry and Mrozowski 1987, 1989; Casella and Symonds, ed. 2005). An increased consideration of workers and work contrasts with earlier studies that focused squarely on artifacts, sites, and technological systems of industry without regard for labor itself. This approach, alternatively characterized as *synchronic*, *particularist*, or in the discipline of the history of technology, *internalist*, does not lack rigorous methodology, nor has it been invalidated by subsequent scholarship (Johnson 2010:80; Law 1991:377–84; Palmer and Neverson 1998:3). The growing attention paid to labor in archeological studies of industrialization instead reflects interest in a wider variety of sites, data sets, and methods as well as efforts to identify underrepresented actors amidst shifts towards market-driven modes of industrial production in the United States in the nineteenth century (Gordon and Malone 1994:347-392; Shackel 1996:17–26).

Although archeological researchers focusing on workers and work have not always explicitly framed their approaches or results in consistent terms, their investigations have largely demonstrated a regard for cultural processes. Regarding this association, the relationships between workers, worksites, households, and technology can be described as a *labor process* or *processes* (Cowan 1983:11; Fracchia and Roller 2014:12–17; Leary 1986). Archeologists studying labor processes have focused on questions regarding class, race, identity, safety, and the consequences of technological adaptations as represented in industrial worksites and households (Mrozowski 2006; Shackle 2000). Their questions have been oriented in a variety of industries that include the manufacture of textiles, firearms, and ceramics; commercial fishing; and extraction industries, such as coal and hard-rock ore mining, to name a few (Botwick and McClane 2005; Knapp et al. ed.1998; Mullins 1996; Shackel 2009; Symonds 2005).

Such studies frequently involve inquiry through records research, conventional archeological survey and excavation techniques, spatial and landscape studies, and the application of materials science. These methods have yielded answers to how industries formed and changed through the utilization of labor regimes, technologies, and landscape, while also providing the means to more fully interpret the physical remains of industrial sites and communities for the public (Casella and Symonds, eds. 2005; Gordon and Malone 1994; Palmer and Neverson 1998). This growing body of literature has also allowed archeologists to develop guidance on evaluating the national significance of industrial sites, communities, and landscapes (Hardesty and Little 2000).

The study of labor processes has presented its own problems, however. Researchers have largely drawn a sharp distinction between *artisan* modes of production (sometimes described as "pre-industrial") in which skilled workers exerted more direct control over their labor in craft industries that required low capital outlays, such as carpentry or blacksmithing, and *industrial* modes of production, where workers of all skill levels frequently contended with diminished influence and agency in capital- and technologically intensive industries (Boris and Lichtenstein 1991; Gordon et al. 1982; Nassaney and Abel 2000; Shackel 1996; Smith 1981). Yet labor processes set within industrial modes of production in the early nineteenth century could widely differ, with skilled workers such as wrought-iron puddlers and machinists exerting significant influence over production methods, apprentice training, and the price of their labor in a manner resembling that found in artisan modes of production (Gordon 1996; Knowles 2013:80; Leary 1986; Meyer 2006). Investigations of the activity areas of the West Point Foundry Archeological Site can help challenge a strict separation of artisan and industrial modes of production in labor processes.

In the disciplines of historical and industrial archeology, concentration on labor processes is relatively recent in North American anthropological archeology but offers the ability to gain understanding into trends in early industrialization in the nineteenth century that written records alone cannot provide. The West Point Foundry Archeological Site, with its diverse activity areas, household sites, and extended period of operation, fortunately affords opportunities to enhance this understanding through addressing the following seven nationally significant research questions.

1. How did industries apart from textile manufacturers adapt waterpower for industrial production in the early nineteenth century? How can the West Point Foundry Archeological Site inform on the adaptation of waterpower for the manufacture of ordnance and heavy capital equipment?

Historical research has demonstrated the importance of waterpower to the expansion of industry in the United States in the early to mid-nineteenth century (Hunter 1979). Scholarship has further shown that not every industry adapted waterpower generation and transmission technologies in the same manner (Reynolds 1983). Industrial archeologists have furthered an understanding of these differences by addressing questions regarding waterpower in the context of landscape constraints, site-specific power needs, and the engineering choices of waterwheel and turbine designers (*IA: Journal of Society for Industrial Archeology* Volume 29, Number 1, 2003; Malone 2005, 2009; McVarish 2008).

The preponderance of this research and its supporting fieldwork have focused on sites like the numerous textile mills of Lowell, Massachusetts, and the Merrimack River valley and other New England river valleys that prominently developed waterpower for the large-scale manufacture of consumer goods (Steinberg 1991). Firms like the West Point Foundry that focused on a broad array of durable goods present a different type of industrial site that lacks stronger representation in the archeological literature of waterpower. The West Point Foundry Archeological Site is particularly intriguing as the site of an ironworking enterprise that manufactured steam engines and early waterpower turbines for national markets but itself did not rely on either technology for generating power from its outset in 1817 through the Civil War. The waterpower system is critical to an understanding of labor processes at the West Point Foundry Archeological Site as it provided activity areas with the power necessary to operate machinery and cranes.

Previous archeological investigations of the West Point Foundry's boring mill determined that the Foundry relied on a 36-foot (11-meter) diameter vertical *backshot* waterwheel spanning 8 feet (2.4 meters) in width for power generation from 1817 through the decades following the Civil War (Finch 2004; Herzberg 2005; Trepal 2008b) (Figure 20 and Photograph 1).[23] The boring mill waterwheel was the centerpiece of the Foundry's waterpower system that relied on differences in elevation to channel water by gravity from nearby Foundry Brook through a system of dams and raceways (Photographs 2-4). These investigations also demonstrated that the waterpower system presents remarkable integrity, with much of the cut-stone masonry used in its construction remaining extant.

Water discharged from the boring mill's waterwheel flowed through a subterranean brick-lined tailrace that followed a course beneath the machine shop area and emptied into Foundry Brook, south of the pattern shop area (Finch 2004; Kotlensky 2013). The designers of the Foundry's waterpower system were successful in adapting the power potential of Foundry Brook to operate multiple activity areas within a single, narrow site—an engineering approach rare for American foundries and ironworking firms of such scale in the antebellum period (Gordon and Malone 1994; Gordon 1996; McVarish 2008). Other manufacturers of the period, especially those located in cities such as Lowell and Lawrence in Massachusetts, committed to more extensive waterpower engineering projects but focused their efforts on the manufacture of finished textiles and other consumer goods. The West Point Foundry's interconnected system, designed to capture, transmit, and generate power through the fall of water alone, set it apart from several competitor ironworking firms of the period, such as the Allaire Iron Works and Novelty Works (both in New York City), the Fort Pitt Foundry in Pittsburgh, and the South Boston Iron Company in Boston, all of which did not incorporate waterpower into their layouts (Finch 2004). The designers of the Tredegar Iron Works in Richmond, Virginia also developed an extensive waterpower system for their enterprise in the late 1830s, drawing water from the adjacent James River and Kanawha Canal through a series of raceways that powered an assortment of overshot wheels that generated power for cannon boring, machining, iron rolling, as well as generating blast for the Foundry's cupola furnaces (Raber et al. 1992:52–53). In comparison to the West Point Foundry Archeological Site, though, the earlier antebellum ironmaking and ironworking archeological record of the Tredegar Iron Works retains much less integrity due in large part to continuous redevelopment and repurposing of the industrial site through the 1950s (Raber et al. 1992:58).

Revisiting collected data as well as further archeological study of the Foundry's waterpower system could help address questions such as:

- How much power could the boring mill waterwheel generate?
- How much machinery could the boring mill waterwheel operate at a single time?
- How did seasonal changes in rainfall affect the available supply of power?
- Did upstream activities, such as logging or till agriculture, impact the downstream needs of the Foundry?

[23] In the design of a backshot waterwheel, also called a "pitchback" or "high breast" waterwheel, water is discharged onto the upper quarter of a waterwheel nearest the penstock (at approximately the ten or two o'clock position, depending on perspective), as opposed to near the top center as in the design of the more common overshot waterwheels of the period (Hunter 1979:64).

- Did the boring mill waterwheel generate power for other activity areas, such as the nearby machine shop? Or did the moulding shop and blacksmith shop utilize their own dedicated waterwheels, as at least two sources suggest (Blake 1849:241–242; Rutsch et al. 1979:66)?

These questions can be answered through process reconstruction (using measurements collected from field data and artifacts), hydrological research (derived from historical rainfall figures and estimating accumulations of silt), and the archeological study of power transmission features and artifacts within and between the Foundry's activity areas. For example, in their 2003 study of the Foundry's waterpower system, archeologists documented the layout of dams and raceways using spatial data collected with the aid of a total station (Finch 2004:143). Based on these data, researchers reconstructed the elevation differences for key parts of the waterpower system. They then demonstrated through analysis of these differences that the system's designers put substantial effort into contouring bedrock and constructing elevated raceways to take advantage of gravity by creating a gradual decrease in elevation from raceway to raceway that offered at least two different points (successively, the blast furnace and the boring mill) where waterpower could be used to do work.

An understanding of American industrialization can be enlarged by examining the adapted landscape of the West Point Foundry Archeological Site within its local surroundings. Like artifacts and the documentary record, the landscape is a product of nature and culture, and nature (power and raw materials) and culture (workers, work, and its products) were instrumental to the operation of the Foundry and its contributions to the development of American defense and industrialization (Norris 2002:148).

As an engineered landscape, the waterpower system of the West Point Foundry Archeological Site offers an opportunity to study the ecological impacts and legacy of such an industrial worksite that was built into a watershed. For instance, what habitats preceded construction of the Foundry, how did these habitats adapt to industrial activities over time, and were there significant impacts to fresh water sources within and adjacent to the Foundry? Collection of pollen samples from across the site can provide data for examining how the facilities removed or reordered natural habitats. For example, recent field research undertaken at the eighteenth-century Fort Necessity battlefield site in southwestern Pennsylvania has demonstrated the validity of palynological methods for reconstructing vegetation patterns that influenced the outcome of the brief battle in 1754 between French and Virginia colonial infantry (Kelso 2013:99–109).

Previous studies undertaken elsewhere for the reconstruction of waterpower systems, such as that of the Wilkinson Mill in Pawtucket, Rhode Island, have proven critical for yielding data on how artisans and engineers adapted an established waterwheel design (a breast wheel) to meet specific conditions that period written sources did not capture (Gordon and Malone 1994:16-19). A similar study can be undertaken of the boring mill waterwheel and its associated features to assist in answering the questions posed above.

It is also worth noting that of the four major gun foundries in operation prior to and during the Civil War, the West Point Foundry and the Tredegar Iron Works were the only foundries that relied on waterpower. In comparison to the West Point Foundry Archeological Site, however, the antebellum-period waterpower system of the Tredegar Iron Works (designated a NHL District in 1977) retains much less integrity (Raber et al. 1992:58).

2. How can archeological research inform on critical changes in ironmaking technologies and knowledge during the nineteenth century?

Historical research has outlined the substantial changes that ironmaking, and to a lesser extent, ironworking, industries underwent throughout the nineteenth century (Knowles 2013; McHugh 1980; Misa 1995; Paskoff

1983; Temin 1964). Archeological research since the 1960s has refined the understanding of these changes through the study of several ironmaking sites, including blast furnace and finery forge sites in the Northeast, Middle Atlantic, and Southeast (Council et al. 1992; Gordon 1996, 2000; *IA* Volume 18, Numbers 1 and 2, 1992; Ransom 1966). This research has largely focused on identifying the responses of ironmakers to the evolution of technology within their industries and the causes for change or stasis. For instance, the transference from Great Britain to the United States of technological knowledge for preheating blast in furnace operation (often termed "hot blast") in the mid-1830s led to significant increases in pig iron production at several furnaces while also decreasing their fuel consumption. The introduction of hot blast was one of the most pivotal innovations in ironmaking and industrialization in the nineteenth century, yet many furnace operators chose not to adopt it, favoring instead to rely on established methods for making pig iron for causes not always reflected in written records (Gordon 1996:111–112).

The owners of the West Point Foundry operated a blast furnace within the Foundry layout from 1827 to 1844, but no written evidence has been found to date that affirms or refutes the adoption of hot blast during its years of recorded operation (Kotlensky 2007). Archeological investigations of the blast furnace and its adjacent blowing engine revealed a remarkable degree of structural and feature integrity across the activity area (Kotlensky 2007; Timms 2005) (Photograph 5). Further study of the Foundry's blast furnace can offer insight into the potential adoption of hot blast by searching for material clues to its use, including water-cooled tuyeres and assemblies for a radiator-like heat exchanger and blast piping (Overman 1850:428–434).[24] [25] Such evidence has been found at other furnace sites of the period. Archeologists, for example, identified water-cooled tuyeres in their excavation of the Bluff Furnace Site in Chattanooga, Tennessee, a hot blast, coke-fired blast furnace in operation just prior to the Civil War (Council et al. 1992:112-126). The potential use of this technology at the Foundry's blast furnace is particularly intriguing since federal ordnance inspectors of the 1840s discouraged the use of hot blast in making pig iron for cannon (Gordon 1996:114). But at least some pig iron makers, including Robert Parrott at his nearby Greenwood No. 1 charcoal blast furnace, appear to have disregarded such preferences and instructed furnace workers to employ hot blast when inspectors were absent (Ransom 1966:144–145).

Investigations of the blast furnace area have recovered large quantities of *firebrick*, a specialized refractory brick that can withstand much higher temperatures than common red brick and was used for lining the interiors of furnaces. Examples of firebrick found in the blast furnace area as well as other locations across the site bear maker's marks, indicating that much of the Foundry's firebrick was imported from places such as Woodbridge and Perth Amboy, New Jersey, in the mid-nineteenth century (Scarlett et al. 2006:29–46). Artifacts such as firebrick are useful for evaluating the site as an industrial consumer that relied on economic development of natural resources both nearby and more distant to sustain its operation.

3. What evidence of ironworking methods can the West Point Foundry Archeological Site yield? How can evidence of these methods supplement or clarify written records?

Workers skilled in shaping iron and steel, such as machinists and blacksmiths, were essential to the operation of ironworking enterprises in the nineteenth century (Gordon and Malone 1994). Historical and industrial archeologists have studied the material evidence of labor situated in many manufacturing settings, recovering data through artifacts, deposits, and features that have contributed to the knowledge of labor processes (Cooper

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[24] In earlier blast furnace construction, a *tuyere* (pronounced like *tweer*) was a nozzle made of cast iron or refractory clay through which blast was directed into the hearth of a furnace (Overman 1850:417). In English usage since at least the eighteenth century, *tuyere* may have derived from the Old French "toiere," a term for a *nozzle* or *pipe* (Oxford English Dictionary 2017).

[25] Because of the higher temperatures generated in the use of preheated blast, cooling the tuyeres of a hot blast furnace was necessary to prevent deformation and melting within the hearth.

et al. 1982; DeVore 1990; Gordon 1983, 1988, 1995). Through an analysis of worksites, recovered tools, and discarded materials, archeologists have traced the transformation of ironworking in settings such as frontier blacksmithing in the Great Plains, firearms manufacture at the Eli Whitney Armory in Connecticut, and early industrial axe-making, also in Connecticut. These investigations have been driven by research questions focused on the organization of work and the uses of tools embedded in changing technological systems that bound an increasing number of manufacturers and markets together in the nineteenth century.

Such studies are especially important for academic scholarship as well as public interpretation because workers who shaped iron and steel rarely recorded descriptions of their work, in what Carol Siri Johnson has described as *prediscursive* practice (2009:59–74). The West Point Foundry Archeological Site offers opportunities to investigate ironworking methods that are not well captured in written primary or secondary sources of the early to mid-nineteenth century. For example, these methods can be identified in two types of artifacts present in the Site, machine waste and hand tools.

Investigations of the boring mill and machine shop (also *turning shop* in period sources such as Blake 1849) recorded dense and intact deposits of ferrous machining waste in the form of metal chips, shavings, filings, and turnings, also called *swarf*, usually near truncated iron tie rods that had once secured machinery to shop floors (Herzberg 2005; Kotlensky 2013; Trepal 2008b) (Photograph 6). Swarf is a byproduct of metal-cutting machinery, such as boring machines, lathes, punches, planers, drill presses, and milling machines. Like debitage in the production of lithic tools, swarf can provide clues to its metal of origin, the tools and machinery used to produce it, and changes in those tools and machines over time. Skilled workers used metal-cutting machines in manufacturing most of the Foundry’s products, notably Parrott guns, but left few written records of how they performed their tasks. As much of the work completed at the West Point Foundry was proprietary (and in the example of the Parrott gun, patented), material culture like swarf constitutes valuable data for informing on labor practices that were not well represented in period literature or were beyond the scope of patent descriptions.

The research opportunities presented in the activity area of the machine shop are especially interesting as the overall machine shop area expanded between 1853 and 1865 with the addition of a significantly larger new building, leaving the earlier adjoining ca. 1839 machine shop as perhaps auxiliary or unused space, thereby preserving traces of machine tool use within its limits (Norris et al. 2006; Rutsch et al. 1979) (Photograph 7). These data from the boring mill and machine shop areas also offer archeological research opportunities for identifying antecedents to the labor processes and machine-tool technologies that were adopted or perhaps neglected in the makeup of the later government-operated Watervliet Arsenal and Washington Navy Yard sites in the 1880s. Future investigations of the machine shop can utilize the extensive machine-tool collections and resources of museums such as the American Precision Museum in Windsor, Vermont, for reference materials, artifacts, and guidance.

Behavioral chain models present useful approaches to the study of unrecorded ironworking labor that generated machine waste such as swarf (Schiffer 2011:29–40). For instance, the *chaîne opératoire* model, developed to outline the individual agency of lithic procurement and tool production within social contexts, can be useful for studying the function of discrete tasks in the flow of work between activity areas of the Foundry. These tasks involved unrecorded “mental operations and technical gestures” undertaken by several individuals who did not necessarily make direct contact with one another in their day-to-day work (Perlès 1987:23, as quoted in Sellet 1993:106). The application of this approach can be compared with data from other intensive ironworking sites of the period to identify commonalities and differences in the manufacture of heavy capital equipment where technical communication was predominantly by word of mouth or visual learning. Although not expressed in the specific terms of a chaîne opératoire model, Peter Shayt demonstrated the usefulness of this approach when he compared the largely unrecorded tasks of workers at two leading North American cymbal manufacturers in the 1980s (1989:35–53).

Hand tools, such as metal hand files and chisels, are another type of artifact that has been recovered in abundance in the boring mill and machine shop areas of the site (Herzberg 2005; Norris et al. 2006; Trepal 2008b). Scholarship in the history of technology suggests that the use of hand files and chisels, employed by workers for removing excess metal from parts prior to fitting, decreased with the rising use of precision machine tools, such as milling machines, over the course of the nineteenth century (Hounshell 1980; Rolt 1986). Considering this trend, future archeological research could address questions such as how often did workers use hand files and chisels to shape castings and machine parts to their intended dimensions and did their use decrease, remain constant, or perhaps increase over the course of the nineteenth century at the West Point Foundry? Does a decreasing trend suggest deskilling through the adoption of machine tools, or perhaps the inverse: that is, the *up*skilling of work, if workers began acquiring more complicated skill sets with the introduction of new machine tools?

Another potential outcome of increased machine tool use was a concomitant rise of workplace tasks and responsibilities for workers. In *More Work for Mother*, historian of technology Ruth Schwartz Cowan traced a similar trend in the growing range and complexity of technology used by women in domestic management roles in the nineteenth and twentieth centuries. Cowan demonstrated that a rise in the consumption of putative labor-saving devices actually increased (or at best, only reordered) the responsibilities and time commitments of women, especially for those in lower and middle-class households (1983).

Besides material and artifact deposits, the activity area encompassed by the Foundry's sprawling blacksmith shop can offer data on heavy industrial forging work. In the blacksmith shop, workers shaped and forge-welded iron into larger machine parts, such as shafts and connecting rods for steam engines and breech bands for Parrott guns that could only be done with the use of water- and later steam-powered hammers. Wrought-iron parts and assemblies could absorb twisting, torsional forces that iron castings of the period could not withstand, such as the propeller shaft vividly depicted in *Forging the Shaft* (1874–1877), John Ferguson Weir's oil-on-canvas painting of the interior of the West Point Foundry's blacksmith shop (Figure 21).

No major archeological studies of similar heavy forge sites of the nineteenth century have been published in the United States in recent decades (see Norris 2002:125-136). Additionally, the archeological record of the blacksmith shop possesses high research value because it may include evidence of both earlier water-powered trip and tilt hammers, and after 1838, steam-powered forging technology; the latter is especially interesting as steam-powered forging hammers were rapidly evolving during the mid-nineteenth century with the innovations of James Nasmyth in Great Britain and François Bourdon in France in the 1840s (Cantrall 1984; Rutsch et al. 1979:105) (Photograph 8).

The activity area encompassed by the ca. 1853 pattern shop of the Foundry has not been previously investigated (Photograph 9). The construction of wooden patterns represented the first material step in making any casting and finished patterns represented a key component of the Foundry's store of intellectual property. Like heavy forge shops, archeological studies of foundry pattern shops are also noticeably absent from the literature of industrial archeology. Future investigations of the West Point Foundry Archeological Site should assess the integrity of stratigraphy in the pattern shop area that can be identified in maps, illustrations, and written descriptions of the West Point Foundry dating to before the Civil War. Data from preserved artifacts such as wood chips, archeological deposits, and features in these areas can provide answers to the following questions: What kinds of hand or machine tools were used in its operation? How was power generated for the pattern shop? What techniques were used in the construction of patterns? Similar studies of marks left on wood chips in prehistoric contexts have yielded data useful for reconstructing tools and their uses (Coutts 1977).

Preserved samples of wood shavings from pattern shop contexts may provide clues as to what species of trees woodworkers used in making patterns. With respect to these data, further questions can be posed regarding the sourcing of wood for patterns—local or imported from a distance? Were certain species of trees favored over others? Is there a change over time in preference for tree species that reflects a growing scarcity of certain trees once common in the local landscape? In his 1849 *History of Putnam County*, William Blake noted that the surrounding Town of Philipstown contributed large quantities of timber to market, especially for shipbuilding (1849:145). Did such external demand put pressure on the supply of wood available to the Foundry's pattern makers?

4. How can the archeological record of the West Point Foundry Archeological Site inform on skill sets in industrial labor processes?

The growth in the number and complexity of labor processes was a defining trend of the industrialization of the United States (Fracchia and Roller 2014:14–17). Labor processes involved what historians and anthropologists have sometimes characterized as skilled, semi-skilled, and unskilled work. But as the literature review provided in the Labor Archeology Theme Study demonstrates, scholarship has grossly defined these divisions in labor prior to the late nineteenth century, after which mass production and professional standardization increasingly dominated labor regimes. The risk, however, of drawing such artificial divisions is that they oversimplify the acquisition of skills pertaining to specific kinds of work.

Archeologists have described the operation of the West Point Foundry by activity areas where workers shaped iron into ordnance and machine assemblies as well as rendered pig iron from iron ore. As summarized under Question Three, archeologists have recovered material evidence of specific kinds of tasks, such as the machining and boring of cast iron. Data from past investigations and future studies can address questions of the experience needed to complete tasks by workers and provide a more refined understanding of labor in a leading foundry and ironworking enterprise before the Civil War. For instance, were the workers of the West Point Foundry subjected to progressive deskilling as foundry and ironworking technologies evolved over the nineteenth century? This research can be undertaken through a synthesis of research of published sources on period machinery and patents (such as the published research of Robert S. Woodbury [1973] and L. T. C. Rolt [1986]), identifying surviving examples of known or similar machine tools present at the West Point Foundry, census records, testimonials from period workers, and the study of patterns of machine tie rod and their associated swarf deposits (Photograph 10). Personal effects, such as pipe bowls and buttons, have also been recovered during archeological investigations of Foundry activity areas (Herzberg 2005; Kotlensky 2007; Trepal 2008). These artifact types can provide clues to the background and identity of workers who attended to tasks in different activity areas of the Foundry.

5. What conditions did workers contend with in ironworking settings as industrialization progressed in the United States during the nineteenth century?

Depictions of industry in photographs, artwork, and written descriptions by outside observers in the nineteenth century highlight the strenuous labor and often dangerous conditions that workers contended with to earn their livelihoods (Slavishak 2008). But these depictions only capture the environments of work at brief moments in time, sometimes in staged, idealized, or dramatized settings. The West Point Foundry Archeological Site, with its several activity areas, offers opportunities to understand the space and pace of dynamic work conditions, without reliance on imagery alone to convey the nature of foundry and ironworking labor. One activity area in particular—casting iron in the moulding shop—drew the most attention of visitors to the West Point Foundry during the early to mid-nineteenth century, and in the present, offers rich archeological evidence of the conditions of work that was critical to the success of the West Point Foundry (Photograph 11).

Prior study of the Foundry moulding shop area identified one of the two ordnance casting pits and other structural features, such as wall partitions and a crane base, depicted in Weir's *The Gun Foundry* (Trepal 2008a). With the aid of plan drawings and diagrams, these data can be used to reconstruct the amount of space available to founders in completing their tasks and the flow of their work. Coupled with dimensions from well-documented castings, such as a 300-pound Parrott gun, archeological researchers can ask questions regarding how much work could be achieved in a day or a week. Archeological research can test or refine assumptions of the historical record, such as production figures quoted by news outlets during the Civil War and later monograph works (Isleib and Chard 2000; Rutsch et al. 1979). Other questions can be aimed at understanding the role of physical strength and the human body in completing work in activity areas across the Foundry and how this role changed over time. The extreme physical labor displayed by the figures tilting the casting ladle in Weir's *The Gun Foundry* is an invitation for further study in this respect. It is important to note that mechanization did not always bring relief to physical labor but only shifted strength from the use of hand tools to the operation of machinery; this shift has been well-documented in industries such as hard-rock and bituminous coal mining following the Civil War (Lankton 1983:1–37; Slavishak 2008:44–50).

Building on the research opportunities proposed under Question Four, investigations of the spatial organization of labor within activity areas of the site are worth pursuing further because they can enhance understanding of how workers of different skill sets and backgrounds interacted and relied on one another to complete tasks, such as those shared between moulders and founders in the moulding shop area. For instance, what was the maximum number of 10-pound Parrott gun molds the moulding shop could prepare in a day? Did this limitation lead to restrictions on the pace of work in the moulding shop and other activity areas of the Foundry?

6. How are the social organization of industrial work and changing labor regimes represented in the domestic lives of laborers and their families? How do the experiences of laborers of the West Point Foundry, within the context of its particular set of industrial processes, social ordering, geographic location, scale, and period of occupation, compare with the lives of laborers at comparable industrial sites?

The West Point Foundry was established in a sparsely populated rural area where access to the natural resources essential to its operations was bountiful. For this reason, Foundry owners contributed to the community housing its workforce at its initial development and at subsequent moments of rapid expansion. As the operations of the Foundry transformed through expansion and the adoption of vertically integrated industrial processes, the demographics of the workforce changed. To meet changing demand, the Foundry management took it into their own hands to establish sufficient housing by building and renting or selling homes to workers. In this process, the company decided upon aspects of house design, size, and location in the living areas of workers (Hartnell 2009; Norris 2009). It established at least three areas of housing on its industrial properties, [redacted] Throughout the period of significance, the Foundry owned about half of the town of Cold Spring, building and sometimes maintaining ownership of rented housing on this land.

Archeological resources and associated collections of the West Point Foundry Archeological District have yielded or are likely to yield nationally significant data answering a broad range of research questions regarding the effects of changing work process and paternalism on the daily lives of its communities of laborers. A major subject of research within labor archeology regards the domestic settings and built environments associated with industrial sites (Fracchia and Roller 2014). Through such lines of evidence, archeologists can question how changing labor processes affected the lives of laborers and their families. One line of questioning within this research domain is the degree to which management exerted control over its workforce in such settings (Beaudry and Mrozowski 1987, 1989; Cowie 2011; Gadsby 2010; Norris 2009; Shackel 1996; Wood 2002). In some cases, through material culture and industrial discipline, firms and corporations attempted to create a work force that acted similarly and held the same values and goals, believing that in this way they could retain a steady supply of reliable employees (Landon 1989:41). Firmly enforced policies and practices, coupled with technological changes, caused greater and more far-reaching changes in the lifestyles and health of workers and their families (Shackel 1996). The employment of corporate paternalism represents a less explicit form of discipline in which companies asserted influence by providing furnishings, services, and goods (Baxter 2012; Gadsby 2010; Palus and Shackel 2006; Shackel 1994:5; Norris 2009).

In settings such as Harpers Ferry, West Virginia (Lucas and Shackel 1994; Moyer and Shackel 2008; Palus and Shackel 2006; Shackel 1996) and Boot Mills in Lowell, Massachusetts (Beaudry and Mrozowski 1987, 1989), archeologists compared assemblages from a variety of contexts, differing by laboring class and time period, to determine whether behavioral changes in consumption accompanied the institution of industrial discipline for different groups. In the armory of Harpers Ferry, new company policies of industrial discipline were institutionalized in the 1840s following an assumption of command by the US Army. In this period the Armory shifted from artisan modes of home-based piecework production to centralized, machine-based manufacture of interchangeable firearm parts (Shackel 1996: 152–162). This change is visible in the archeological record in the sudden disappearance of work-related items from domestic areas as the practice of home-based piecework was eliminated. Concurrent with changing work discipline, the new military ownership drastically altered the built environment of the industrial complex, homogenizing and arranging architecture into a rigid geometric grid (Shackel 1996, 2004). The archeological record of Harpers Ferry also yielded insights into the ways that different classes of armory workers reacted to changing industrial discipline within the broader context of consumption. Domestic assemblages from households of a higher class of master armorer reflect growing dependence upon meat from mass-market sources, with greater variety in types of meat consumed and increased purchases of fashionable consumer goods. Contrarily, the reduced wages of armory workers may have been responsible for a slight increase in home-based food production such as animal butchering and adoption of a ceramic assemblage fashionable generations earlier (Shackel 1996: 111–145; Lucas 1993).

In comparison to other sites which have contributed to an archeological understanding of the domestic sites of laborers, the West Point Foundry Archeological site offers a unique material signature owing to the skilled foundry and machining process its industry entailed. Because of the well-documented use of vertically integrated production and management at the West Point Foundry, archeologists have the opportunity here to further understand how this labor regime might have affected the lives of its workers and their families. Research within and around the West Point Foundry Archeological Site includes a vast comparative dataset recovered from domestic settings of the entire spectrum of Foundry workers and management. [redacted] Though it is located outside the boundaries of the site, archeological resources from the estate of William Kemble could potentially represent a comparative dataset from the very top of the economic scale. The site has already been subjected to limited archaeological investigation which confirmed the presence of intact deposits from the early nineteenth century (Norris and Martin 2007, Norris 2009). Moreover, many homes which historically belonged to workers and management of the Foundry can be found throughout the town of Cold Spring. They could also provide an archeological dataset which would add to the value of a comparative analysis of the domestic settings within the grounds of the Foundry.

Research conducted at the West Point Foundry Archeological Site has already yielded contributions to research questions of national significance to labor archeology. In a dissertation on the archeology of the West Point Foundry, Elizabeth Norris (2009) examined cultural continuity and its persistence under corporate paternalism. In addition to an analysis of the various archeological collections from different social and economic classes of workers and owners at West Point Foundry, Norris employed a variety of interdisciplinary sources including documentary research, cultural landscape, and spatial analysis to consider how paternalism was manifested in the layout of the greater community of Cold Spring and the consumption patterns of the owners/managers and the workers (2009:3).Within this framework she considered how life at Cold Spring differed from industrial environments structured by an overweening sense of paternalism.

Norris compared ceramic assemblages from domestic sites associated with the Foundry to those of Harpers Ferry and Lowell's Boot Mills, considering whether the ceramic assemblages reflect ideal consumption patterns of the time or the particular effects of paternalism. Overall, her analysis finds that different cultural practices prevailed within this single manufacturer rural industrial community (2009:vii). In comparison to other industrial communities, West Point Foundry worker ceramic assemblages displayed an abundance of tea wares in combination with a predominance of more bowls than plates. She suggests that a variety of factors led occupants to favor a diet of less expensive cuts of meat, but contrarily, an investment in the increased expense of formal ritualized middle-class tea consumption (2009:276). Overall, Norris notes a lower subscription to typical American consumer ideals in West Point Foundry assemblages, though across the period of its history she detects an upward trend. A number of factors likely contributed to the particular ceramic patterns observed at West Point Foundry including the relatively light paternalistic control, good access to consumer markets, and the presence of a company store for the earliest period of its history (2009:274).

Norris' research hints at the data potential of the domestic deposits of the West Point Foundry Archeological Site. Archeological data from domestic settings can provide a richer picture of both the innovative technological and engineering accomplishments of the Foundry and illuminate aspects of the daily lives of the men and women that worked and lived in its shadow. Regarding the paternalist system of management employed at the Foundry at different throughout its operation, the archeological record may answer a number of significant questions. What specific strategies did management employ and how did they change over time? To what degree did workers resist paternalistic efforts, and for what reasons? Did workers seek additional sources of income outside the paternalist system? Were there areas of town that lay more-or-less outside of paternalist control?

The unique industrial and social context of the skilled work of the Foundry can provide a unique dataset to enrich the archeological discipline's capacity to answer nationally significant questions about the effects of industrialization on the American people. With future research, it will be possible to correlate this data with the that gathered from other comparable industrial contexts.

7. How does the material culture recovered from workers' housing reflect differences in the identity and skill of the distinct groups laboring at the West Point Foundry across time? How do unique industrial and social conditions reflect or shape the broader trajectory of immigrant experience and identity?

Richard Frankaviglia (1991) describes historic mining towns, akin to the isolated single-industry corporate settlement of the Foundry, as fundamentally *stratified* and *seriated* landscapes featuring discrete accumulations of groups differentiated by ethnic or racial identity. Each group may occupy a distinct space in the landscape that may correspond to its social place within a laboring hierarchy. Moreover, in meeting changing technological or labor needs throughout the development of an industrial site, new groups often succeed or displace older ones. Each group may leave its distinct material traces on the landscape in the form of landscape, architecture, or material culture. In such cases where the documentary record is poor, archeology can reveal important information about the identities, adaptations, and living conditions of successive or contemporaneous groups of laborers.

The Foundry prospered in an industry in which technical knowledge in the form of skilled labor was closely guarded as a matter of national security (Grossman 1994). Historical documents reveal that to get around prohibitions against exporting skilled labor, the operators of the Foundry gathered skilled labor of European origin using a number of unconventional means, including outright subterfuge (Grossman 1994; Norris 2009). While the documentary record indicates generally British and Irish origins for many of these workers, archeological evidence from at least one settlement (Rascal Hill) included ceramics, coins, and other items from France, Austria, Venezuela, Scotland, Germany, Hungary, and Bohemia discovered in association with technical devices and children's toys (Grossman 1994). This evidence suggests that the workforce of the Foundry likely included, for at least one period of its development, a diverse workforce of highly skilled workers and their families.

The archeological resources [redacted] have yielded, and are likely to yield, substantial archeological information about the lives and identities of the variety of skilled and unskilled foundry workers of various immigrant origins across the history of the Foundry (Deegan 2006; Grossman 1990; Norris 2009; Norris et al. 2008). It can also provide information about the adaptations of these groups to the social environment of industrial work across time. Previously excavated portions of [redacted]

These data have the potential to provide answers to a number of nationally significant research questions related to the identities and adaptations of this pluralistic labor force. These data can address questions designed to understand how the individual trajectories of particular groups are shaped within a relatively organized corporate body. As stated in the *Labor Archeology of the Industrial Era National Historic Landmark Theme Study* (Fracchia and Roller 2014 17–18):

> Work is conducted socially among, between, and for groups of people as they are drawn into, forced under, or live within the economic systems in which they become dependent as both producers and as consumers. As a result, labor relations are nationally significant in the way divisions of race, gender, and ethnicity are created, amplified, or maintained within the broader context of American social history and are used to structure or classify the population.

Archeological scholarship has examined material culture for patterning that reflects the racial, racialized, or ethnic identification of laboring groups in ways that range from identities internally constructed to identities externally imposed (Epperson 2004; Orser 2007; Singleton and Bograd 1995). The conjunctions of relatively structured classes defined by race, ethnicity, skill, class, and other differentiations have been the subject of anthropological questioning by archeologists in a number of historical settings (Hardesty et al. 1994; Mulrooney 1989; Reckner 2009; Rogge 1995; Walker 2008).

For example, Mark Walker's (2008) research analyzed consumption patterns amongst a hierarchy of railroad workers in West Oakland, California in the late nineteenth century. This group, composed of white American-born unionized skilled workers and immigrant and African-American unskilled laborers were differentiated by nativist and racial discourses, craft skill-based union membership, and the perceived skill levels of certain types of workers. Walker compared the consumption of faunal material and dining ceramics from a number of domestic sites occupied by each group. He found that groups made consumer choices shaped by symbolic differences that existed between the quality and quantity of material objects these groups consumed. While the unskilled workers spent more on cuts of meat, the skilled craftsmen consumed more expensive sets of formal dining ware, participating for their own reasons in the ritualized dining that came along with the Victorian middle-class cult of domesticity. Walker suggests that these variations do not necessarily suggest an acculturation or an emulation of middle-class values, but a situated negotiation based upon local conditions. Specifically, he contends that the differences in consumption patterns reflect efforts by native-born Americans to differentiate themselves from recent immigrants.

Personal effects such as pipe bowls and buttons have been recovered during archeological investigations of Foundry activity areas (Herzberg 2005; Kotlensky 2007; Trepal 2008). A growing body of archeological research significant to an examination of the workforce at the West Point Foundry uses material culture to examine the trajectory of the Irish diaspora as they negotiated new identities as American citizens, while maintaining distinct ethnic or political ties to their homeland (Brighton 2008, 2009; Fracchia 2014; Reckner 2001). One topic of this research examines the symbolism of various political and cultural motifs on molded clay tobacco pipes, common items of work and home sites of the diaspora (Brighton 2008, Fracchia and Brighton 2015; Reckner 2001). By the 1850s, such pipes were primarily associated with working-class laborers, who used the objects and their prominent imagery as a medium to express the subtleties of working-class political ideology (Reckner 2001:105). Paul Reckner's (2001) analysis of tobacco pipes from the Five Points neighborhood in Manhattan, New York, examines the complex ways that immigrant groups wielded ethnic or patriotic imagery on pipes to negotiate their economic and political positions within both a multicultural American society and a competitive economic labor market. Reckner compared pipes recovered from deposits associated with a pre-1850s Irish-occupied tenement and an 1870s-era home of several tradesmen and their families. The earlier assemblage featured pipes largely free of political symbolism, representing a time of strong nativist discrimination against the largely Catholic working-class Irish immigrants. The ca. 1870s assemblage, on the other hand, featured prominent Irish nationalist imagery including harps, shamrocks, and the mark of the Irish anti-colonialist, "HOME RULE" movement. Reckner (2001:109) suggests that while the earlier generations "were disinclined to identify themselves with a patriotic imagery, or to openly contest the American national identity and ideology linked to these symbols," by the 1870s barriers to establishing white American identity was no longer at risk and symbolic political participation in Irish nationalist sentiments became blended with labor struggle.

Recent archeological scholarship cautions that the simplistic identification of ethnicity through artifact assemblages is complex, and the degree to which individual material objects delineate ethnic identification is a major subject of disciplinary debate. For this reason, research questions concerning the relationship between ethnic affiliation and material culture require deep critical evaluation in the context of other historical or material evidence. For example, an ethnic community's patterned consumer waste may be as likely to reflect an adherence to national mass consumer trends or reflect economic conditions, as to establish ethnic differentiation based upon traditional practices, identity, or resistance. The unique material and social setting within which the laborers of the West Point Foundry worked and lived presents a fascinating context to ask nationally significant research questions regarding the lives and identities of America's early immigrant laboring communities.

Comparative Analysis

The national significance of the West Point Foundry Archeological Site is further supported through a comparison with other similar industrial enterprises and archeological sites, including a selection of existing NHL and NPS properties. These comparisons highlight four distinguishing characteristics of the site that exemplify its national importance. As the contextual information in prior discussions has shown, other major American foundry and ironworking enterprises were also active during the West Point Foundry's period of national significance (1817–1867), yet few sites associated with these industrial peers retain sufficient archeological integrity to permit worthwhile study. Second, as a single property, the West Point Foundry Archeological Site presents the material culture of the pivotal technology and labor of nineteenth century ironmaking and ironworking in a manner that no other comparable and period archeological site offers. Third, [redacted] a key avenue for research lacking from other contemporary foundry sites. And fourth, the West Point Foundry Archeological Site possesses a high measure of archeological integrity and is protected within a dedicated park preserve that is accessible to both researchers and the public alike.

This last characteristic reinforces the site's potential as a standout opportunity to introduce to the public an influential but lesser-known integrated industrial enterprise that predates ones of more recent periods, such as the sprawling steel and automobile manufacturing plants of the twentieth century. Table 1 summarizes the known ironmaking, ironworking, and domestic resources identified with each of these sites as well as its archeological research potential and public accessibility, followed by brief summaries of each site.

Table 1. Summary of Comparable Ironmaking and Ironworking Sites.

Site	**Years of Operation**	**Dedicated Foundry**	**Boring Mill**	**Water-powered**	**Blast Furnace**	**Rolling Mill**	**Workers Housing Within Site**	**Archeological Research Potential (ca. 1800 to 1865)**	**Public Accessibility and Interpretation**
Saugus Iron Works National Historic Site	1647–1670			X*	X	X		Low	X
Hopewell Furnace National Historic Site	1771–1880s			X	X		X	Low	X
Columbia Foundry	1800–1854	X	X	X	?			High	
Bellona Foundry	1814–ca. 1877	X	X	X				High	
Fort Pitt Foundry	Ca. 1804–1878	X	X					Low	

South Boston Iron Company	1817–ca. 1890	X	X					Low	
West Point Foundry Archeological Site	1818–ca. 1911	X	X	X	X		X	High	X
Tredegar Iron Works National Historic Site	1837–1957	X	X	X		X		Low	X
* *X* denotes documented presence, *?* denotes unverified presence.									

Saugus Iron Works and Hopewell Furnace National Historic Sites

Called *Hammersmith* at its outset in 1646, the Saugus Iron Works is in present-day Saugus, Massachusetts, and is recognized as the first sustained ironmaking and ironworking enterprise in Great Britain's North American colonies (Hartley 1957; NRHP Reference Number 66000047). Between 1646 and 1670, the integrated iron works layout included a blast furnace for producing cast-iron goods and pig iron, a finery forge for refining pig iron into wrought-iron blooms, and a mill for rolling blooms into iron stock for sale to blacksmiths. The iron works was provided with power by a series of waterwheels, with water drawn from the adjacent Saugus River (Hartley 1957). Although longer-term success eluded its owners, several of the former workers of the Saugus Iron Works went on to establish less-capital intensive bloomery forges at other locations in the colonies.

Established in 1771 by an experienced ironmaker, the Hopewell Furnace in Berks County, Pennsylvania, prospered until the mid-nineteenth century as a maker of cast-iron consumer wares and pig iron (Gordon 1996:242–243; NRHP Reference Number 66000645). The Hopewell Furnace was the focus of what later historians would describe as an *iron plantation* in which an owner or *ironmaster* provided both a livelihood as well as households and access to retail goods for workers and their families. Though they stand out as examples of iron industries of their respective periods, the archeological records of both the Saugus Iron Works and Hopewell Furnace were compromised in efforts to reconstruct buildings and structures. Documentation of soil stratigraphy and deposits was largely disregarded in pursuit of masonry features and, therefore, both sites offer little research potential for future investigations.

The Columbia and Bellona Foundries

Known in its earliest years as the *Foxall Foundry* for its chief organizer, Henry Foxall, the Columbia Foundry was a regular maker of ordnance for the federal government from ca. 1800 to the early 1840s (Gorr 1971/1972). Foxall established his foundry and boring mill on the north bank of the Potomac River in ca. 1810 adjacent to present-day Foundry Branch (formerly Deep or Mill Creek) in Georgetown, District of Columbia. In 1831, contractors completed the Chesapeake and Ohio Canal alignment adjacent to the boring mill, providing another transportation option to supplement the foundry's frontage on the Potomac River. Though notably one of the few foundries producing ordnance before the War of 1812 to survive into the antebellum era, production at the Columbia Foundry ceased by 1845 due to the aging and obsolete state of its machinery (at least per George Starbuck, a millwright at the foundry) as places like the Fort Pitt Foundry and the West Point Foundry began to secure regular contracts with both the Navy and the Army (Gorr 1971/1972:53). The Columbia Foundry is historically noteworthy as an early if not the earliest American foundry to adopt Peter Verbruggen's horizontal cannon boring methods that had been introduced into British ordnance production in the late eighteenth century (Gorr 1971/1972). The Columbia Foundry, like the later West Point Foundry, relied on waterpower and may have also included a blast furnace within its layout, though previous research remains unclear in this latter regard.

The Bellona Foundry, located along Spring Creek south of the James River in Chesterfield County, Virginia, initially manufactured ordnance under the direction of John Clarke ca. 1814 and continued making cannon into the 1850s for the Navy under Junius L. Archer (NRHP Reference Number 71000975; Tucker 1989:65, 68; 278-279). Although the Bellona Foundry did not secure a share of contracts equal in volume to those of the larger gun foundries in Boston, Cold Spring, Pittsburgh, and Richmond before the Civil War, it provided enough capacity to remain a noted ordnance maker for Confederate forces (Daniel and Riley 1977). Given its proximity to a perennial tributary to the James River, the Bellona Foundry probably relied on water for its power generation needs. No notable archeological surveys or evaluations of the sites of the Columbia and the Bellona Foundries have been undertaken or published to date and a review of recent aerial imagery suggests that both sites may retain a significant measure of sub-surface integrity (but with no extant industrial buildings or structures clearly evident within either site). Photographic documentation of buildings associated with the Bellona Arsenal – a firearms manufacturing component of the Bellona Foundry – was completed by HABS in the late 1930s (HABS-VA-139). In comparison to the West Point Foundry Archeological Site, neither the Columbia Foundry nor Bellona Foundry competed in national markets for heavy capital goods, such as marine steam engines, nor is neither site directly accessible for archeological study or public interpretation.

<u>The Fort Pitt Foundry and the South Boston Iron Company</u>
Joseph McClurg established the Fort Pitt Foundry in Pittsburgh ca. 1804 and by the end of the War of 1812 had manufactured a modest amount of ordnance for the Navy (Fox 2002; Tucker 1989:64). The Fort Pitt Foundry was likely reestablished at a larger site near the Allegheny River by the 1820s that included a foundry and boring mill. Interestingly, during its first few years of ordnance production, the Fort Pitt Foundry may have utilized horses to drive its cannon boring machinery but these were replaced with steam power within a few years. Following its purchase under the partnership of Charles Knap and William Totten in 1841, the Fort Pitt Foundry became one of the principal gun foundries in the nation and specialized in making large-caliber, smooth-bore cast-iron ordnance during the Civil War for both the Army and the Navy.

In 1817, Cyrus Alger (1781-1856) established the South Boston Iron Company on filled-in land in the present-day South Boston neighborhood of Boston, Massachusetts (Seasholes 2003:289). The son of Abiezer Alger, a successful iron founder in nearby West Bridgewater, Cyrus Alger began securing contracts for ordnance with the Navy by the early 1840s but had been producing bronze ordnance for the Army since the 1820s (Hazlett et al. 1997; Ripley 1970). Based on a municipal directory advertisement, the South Boston Iron Company was manufacturing a range of iron castings and forgings in addition to its federal ordnance work (*The Boston Directory* 1848-1849:30). Given the lack of waterpower potential near the site, the South Boston Iron Company, like the Fort Pitt Foundry, probably relied on steam power, with mineral coal supplied by ship. Unlike the water-powered West Point Foundry, their mutual reliance on steam power was a feature more common to foundries in the decades following the Civil War. However, the Fort Pitt Foundry and the South Boston Iron Company have not been the focus of published historical monographs or thoroughly-researched comparative studies. Compounding this lack of attention, the sites of both foundries have been intensively redeveloped since their abandonment sometime after the 1880s and at present are not interpreted or accessible to researchers or the public (Photographs 15 and 16). Both enterprises, like the West Point Foundry, poorly coped with the negligible demand for cast-iron ordnance following the Civil War (Rutsch et al. 1979).

<u>Tredegar Iron Works National Historic Landmark District</u>
Beginning operation in 1837, the Tredegar Iron Works was built adjacent to the James River and Kanawha Canal in Richmond, Virginia, and drew water from the canal for generating power (Dew 1999; NRHP

Reference Number 71001048; Raber et al. 1992). After Joseph R. Anderson (1813-1892) assumed management in 1841, the Tredegar Iron Works became a leading maker of ordnance by the 1850s. The layout of the iron works included many of the same foundry and ironworking capabilities as the West Point Foundry but also included puddling furnaces and a rolling mill. Under Anderson's direction during the Civil War, the Tredegar Iron Works provided half of the domestic-made ordnance in service with Confederate forces and armor for warships, including most notably the CSS *Virginia*. Surviving the war largely intact, the Tredegar Iron Works remained a generally profitable manufacturing enterprise into the twentieth century. But continued profitably led to regular redevelopment of the property that resulted in the removal of several of the earlier buildings and structures, leading to a loss of archeological value that could aid in the study of the antebellum aspects of the overall site (Raber et al. 1992). The site of the Tredegar Iron Works is the only major foundry and ironworking peer of the West Point Foundry that is open to the public as a unit of the NPS.

Conclusions

The West Point Foundry Archeological Site is nominated as a NHL in accordance with Criteria 1 and 6, under the NHL Thematic Framework categories of Shaping the Political Landscape, Developing the American Economy, and Peopling Places. The West Point Foundry Archeological Site is nationally significant in the areas of military institutions and activities, extraction and production, and historic non-aboriginal archeology.

The West Point Foundry was one of only six major American foundry and ironworking enterprises that possessed the capability to manufacture large quantities of heavy cannon between the War of 1812 and the Civil War. The Foundry made advanced types of cast-iron ordnance such as the Parrott gun and the naval guns of the USS *Monitor* that were critical for the Union's success in the Civil War. Besides making cannon, the West Point Foundry became a major national manufacturer by the 1830s of steam engines for transportation (including the first American-made railroad locomotive in 1830), stationary power generation, and machinery for use in making sugar, iron, and the excavation of railroad bridge piers, to name a few examples. Heavy capital equipment such as that made by the West Point Foundry provided the means to extend industrialization and the emergence of nationally oriented consumer markets of the 1860s and later. Yet due to demolition and redevelopment, most of the West Point Foundry's ordnance-making and ironworking peers are poor candidates for archeological research at present.

In summary, the West Point Foundry Archeological Site is an industrial archeological site with no equals in the nation (Norris 2009:58, 313). Archeological resources of the West Point Foundry Archeological Site offer opportunities to study the adaptations of early to mid-nineteenth century ironworking technologies for making cannon and machinery that specifically served national interests (Norris 2002:101). Most of the daily correspondence, drawings, and records that managers and workers of the West Point Foundry generated on a day-to-day basis have been lost. But the West Point Foundry Archeological Site presents extraordinary integrity for archeological investigations of its diverse array of worksites as well as adjacent households that can yield data unavailable through historical research alone. The site possesses further national significance because its archeological record offers researchers new opportunities to address questions of industrialization and emerging labor networks and regimes during a period of marked social and economic transition for Americans (Fracchia and Roller 2014:12-17; Meyer 2006:44-45). For researchers and the public alike, the West Point Foundry Archeological Site conveys the West Point Foundry's importance to the course of the Civil War and the expansion of the American way of life through industry in the nineteenth century, making it worthy of recognition as a NHL.

6. PROPERTY DESCRIPTION AND STATEMENT OF INTEGRITY

Ownership of Property		Category of Property	
Private:	X	Building(s):	
Public-Local:		District:	
Public-State:		Site:	X
Public-Federal:		Structure:	
		Object:	

Number of Resources within Boundary of Property:

Contributing		Noncontributing	
Buildings:	1	Buildings:	1
Sites:	11	Sites:	2
Structures:	3	Structures:	
Objects:		Objects:	
Total:	15	Total:	3

PROVIDE PRESENT AND PAST PHYSICAL DESCRIPTIONS OF PROPERTY

Environmental Setting

Within view of the Hudson River, the physical setting of the West Point Foundry Archaeological Site is marked by dramatic landscape relief that is distinctive of the surrounding Hudson Highlands (Map 1). The site is underlain by granite gneiss bedrock geology common to the Reading Prong, a physiographic subprovince of the New England Upland section of the greater New England physiographic province (Fenneman 1938). This dark gray, erosion-resistant metamorphosed rock outcrops in several locations of the site, most prominently in the stream bed and banks of Foundry Brook. During the Pleistocene geologic epoch (2.5 million to ca. 11,500 years before present), the site was overlain by the Laurentide Ice Sheet that extended south through the Hudson River Valley and across present-day Manhattan Island and Long Island Sound. The retreating ice sheet deposited a dense stratum and elevated surficial geologic features of glacial till sediments (i.e., sand, gravels, and cobbles) across the site and surrounding landscape, while glacial melt waters cut into bedrock to form stream channels that flowed into the Hudson River. Foundry Brook flows through one of these channels, draining the Hudson Highlands east and north of the Village of Cold Spring. Skilled moulders of the Foundry likely took advantage of these sand-rich deposits for preparing molds for casting but burrow pits of any kind have not been previously recognized within the site or its vicinity.

From the northeast, Foundry Brook enters the site at its northern extreme boundary, passing over and through the Upper Dam of the Foundry waterpower system. Following a roughly level course to the south for approximately 950 feet (290 meters) where it meets the Main (or Lower) Dam of the Foundry beneath the two-span bridge that carries NYS Route 9D over the brook. The Main Dam forms an artificial break in the stream course but also marks a sharp change in the natural relief of the site. From the Main Dam, Foundry Brook drops rapidly in elevation as its course continues south, descending 115 feet (35 meters) in elevation over 2,000 feet (610 meters) to its mouth at Foundry Cove, near sea level; the most southern reach of Foundry Brook rises and falls with the tide. At its upper reach, below the Main Dam, Foundry Brook cascades over falls of boulders and cleaved bedrock, descending through a series of pools as it follows the toe of the adjoining slope to the east. In the late summer, the flow of Foundry Brook typically reduces to little more than a rivulet, whereas in the spring, the stream can overflow its banks with water from snow melt.

The terrain flanking Foundry Brook immediately south of the Main Dam is marked by a narrow gorge that spans approximately 150 feet (46 meters) from west to east that progressively fans out to a broader, level alluvial plain, spanning approximately 1,400 feet (427meters) from west to east at its widest where it meets the northern edge of Foundry Cove Marsh. The steep sloping bank of the valley crests at approximately 140 feet (43 meters) above mean sea level (AMSL) along its western flank adjacent to present-day Chestnut Street. The western slope of the site descends to the south and east over a distance of approximately 500 feet (152 meters) to approximately 10 to 20 feet (3 to 6 meters) AMSL at the valley floor. Ascending east of Foundry Brook, the contours of the valley bank rise sharply again, returning to an elevation of 140 feet (43 meters) AMSL along the eastern boundary of the site.

Apart from its upland component, the site encompasses Foundry Cove Marsh, a lush, grassy wetland between the upland area of the site and Foundry Cove. A tidal inlet of the Hudson River, Foundry Cove borders on the northwestern shore of nearby Constitution Island and the artificial embankment of the present-day Metro-North Railroad corridor that follows a northwest to southeast course. The upland western extension of the site, north of Foundry Cove Marsh, follows the toe of a hillslope that ascends to the north and east and overlooks Foundry Cove. The West Point Foundry Archeological site also includes the upland area encompassed by Foundry Dock Park, a small area of level land less than an acre (0.4 hectares) in area situated along the eastern shore of the Hudson River, immediately west of the Metro-North Railroad corridor.

In the present, the site is populated by diverse, maturing stands of temperate forest hardwood trees, moderate understory, and several species of Eastern North American fauna, such as white-tail deer and red fox, that have adapted to wooded areas near neighborhoods. During the operation of the West Point Foundry, trees were cleared from the valley floor and farther north toward the Main Dam for the construction of buildings, structures, and features but the hillsides were not completely denuded as period photography shows. The shoreline of Foundry Cove has also remained largely the same as during the years of the Foundry's operation.

A range of saltwater fish and aquatic life inhabit Foundry Cove and its Marsh, forming a part of the larger Hudson River Valley estuary ecosystem; migratory anadromous fish travel a short distance up Foundry Brook to spawn. Above-ground features and deposits of the Foundry are visible throughout the site at present. Three key components of the waterpower system—the Upper and Main Dams and Battery Pond—are the most intact above-ground components of the Foundry's built-environment dating from its period of national significance, while the two-story brick *1865 Office Building* remains the only intact building of the same period to survive into the present. The site remains susceptible to the impacts of major storm events, as witnessed in August 2011 when excessive rainfall from Hurricane Irene overflowed the banks of Foundry Brook, depositing several inches of sediment across the alluvial plain that surrounds the densest concentration of the West Point Foundry's former industrial activity areas.

Contributing Resources

The proposed West Point Foundry Archeological Site NHL boundary encompasses a total of 15 contributing resources: 11 resources related to foundry and ironworking technology and worksite labor, [redacted] and one building—the two-story 1865 Office Building (Table 2).[26]

[26] In previous archeological studies and summaries, the West Point Foundry Archeological Site has been mapped as 12 and 19 areas (respectively Barry 2009 and Valentino 2003), generally associated with the past operation of the West Point Foundry and close-by habitation of its workers. The area designations employed by each source are not provided here as both numbering systems

Table 2. Summary of Contributing Resources.

Resource	Activity Area, Structure, or Building	General Function	Year/s of Field Investigation	Map References	Figure and Photograph References
Blast Furnace Area	Activity Area	Worksite	1978-1979, 2004, 2005	2a, 2b, 3	Figures 2, 3; Photograph 5
Moulding Shop Area	Activity Area	Worksite	1978-1979, 2007	2b, 3, 4, 5	Figures 2, 4, 8; Photograph 11
Pattern Shop Area	Activity Area	Worksite	1978-1979	2b, 3, 5	Figures 4, 10; Photograph 9
Machine Shop Area	Activity Area	Worksite	1978-1979, 2006, 2008	2b, 3, 4, 5	Figures 4, 11; Photographs 6, 7, 10
Blacksmith Shop Area	Activity Area	Worksite	1978-1979	2b, 3, 5	Figures 12, 21; Photograph 8
Gun Testing Platform Area	Activity Area	Worksite	1989-1990	2b, 5	Figures 4, 15
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Boring Mill Area	Activity Area	Worksite	2003, 2004, 2006, 2008	2b, 3	Figures 2, 20; Photograph 1
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Upper Dam	Structure	Waterpower Generation	2003	2a, 3, 4, 5	Photograph 2
Lower/Main Dam	Structure	Waterpower Generation	2003	2a, 3, 4, 5	Figures 2, 4; Photograph 3
Battery Pond	Structure	Waterpower Generation	2003, 2006	2a, 2b, 3, 5	Photograph 4
1865 Office Building	Building	Administration	2003, 2004	2b, 5	Figure 4; Photograph 17
Foundry Dock Area	Activity Area	Worksite	Not previously investigated	2d, 4	Photograph 18

The following discussion highlights the results of 14 archeological investigations of the West Point Foundry Archeological Site since 1979 that provide characterization of the site's past physical appearance and setting. Of

delineate and group areas by arbitrary spatial divisions or through proximity between resources that lack direct functional association (i.e., the blacksmith shop with the adjacent Battery Pond). Although neither system is necessarily deficient from an organizational standpoint, they may not account for changes in the spatial organization of work and habitation over time across the Site, and therefore should be considered accordingly for future research and investigations.

the 14 investigations discussed, 10 were undertaken by Michigan Technological University's Industrial Archaeology Program under the direction of Dr. Patrick E. Martin from 2002 to 2008 (Martin 2009). These investigations—involving background and primary sources research coupled with archeological fieldwork—have aimed at documenting the archeological record of the site and retrieving data that permits a richer understanding of the West Point Foundry's history and cultural significance. The results also have provided the means to assess the site's integrity for past and future research, which is briefly summarized at the end of the discussion. Previous investigations have identified over 170 discrete archeological features and material deposits and recovered over 200,000 artifacts, while recording extant structures and one building associated with the site's period of national significance (1817–1867).

Previous Investigations

Site Survey by Cultural Resources Management Services (1978–1979)

Cultural Resources Management Services (CRMS) of Newton, New Jersey, completed extensive background research, pedestrian reconnaissance, and limited test unit excavations of the West Point Foundry Archeological Site under the direction Edward Rutsch (Rutsch et al. 1979; also *CRMS study* or "Ed Rutsch" survey).[27] The site was entered in the site files of the New York State Office of Parks, Recreation, and Historic Preservation (the State Historic Preservation Office [SHPO]) in 1973 as the *West Point Foundry District* as Site Number 07952.00001, and this identifier has been used by subsequent investigations of the site.

The first archeological treatment of the site, Rutsch's investigation focused on a preliminary assessment of seven activity areas for above-ground extant buildings, structures, and a sample of features and deposits, using background research to guide the field survey. Of the seven activity areas that Rutsch assessed, five contribute as resources to the site as an NHL: the blast furnace, moulding shop, pattern shop, machine shop, and blacksmith shop (1979:69–84, 126–198). The remaining two areas not assessed at the time of Rutsch's survey are the boring mill and Civil War-period gun testing area.

Field investigators documented the blast furnace stack as constructed of local granite gneiss stone, with one intact brick-lined tuyere arch, and the base of the stack and nearby blowing engine foundation extant, though buried beneath accumulating soils and masonry rubble (Rutsch et al. 1979:77–84). In analysis of their field results, report authors contended that the water discharged from the adjacent blowing engine waterwheel did not flow back to Foundry Brook but through a stone-lined channel under the furnace stack and discharged into nearby Battery Pond. Channeling water beneath a blast furnace was a highly unusual arrangement for water-powered blast furnaces of the period that would be confirmed in a subsequent study of the area and its features (Timms 2005). Investigators also documented a deposit of slag in excess of several feet, between the buried furnace base and Foundry Brook. Historical research showed that the charcoal-fueled blast furnace had remained in operation from 1827 to 1844, ceasing its last campaign due to the high costs of procuring iron ore from the local area.

In their investigation of the moulding shop, archeologists identified in historical records several adjoining buildings and additions that date in use for preparing molds and casting iron between 1817 and 1865 (Rutsch 1979:135). This expanding complex began in 1817 with an L-shaped single-story building, 90-foot by 40-foot (27-meter by 12-meter) and 22-foot (7-meter) in height, that housed both moulding and casting work (featuring

[27] Edward Rutsch, an early and noted practitioner of CRM in the southern New York and New Jersey area, was also an active researcher and investigator of the region's industrial heritage, later publishing an article in the SIA journal with West Point Foundry report co-author Brian Morrell that summarized their survey of the Long Pond Ironworks site in nearby Passaic County, New Jersey (1992:40–60).

two air furnaces), with a single circular chimney built into its southern end. The moulding shop area, roughly aligned north-south, expanded with at least five additions before the Civil War—the largest, a two-story 218-foot by 68-foot (66-meter by 21-meter) step-gabled brick building built ca. 1839, housed two cupola furnaces. Investigators included a discussion of the boring mill within their research of the moulding shop because of the proximity between the two activity areas but did not undertake any intensive surface or sub-surface investigation of its features during their field survey.

As the report authors explain, the locations of pattern-making areas prior to ca. 1853 are difficult to identify because period sources describe pattern making as work shared between the boring mill, machine shop, and moulding shop areas (Rutsch et al. 1979:168). By the mid-1850s, however, a dedicated pattern shop and storage area had been established west of Foundry Brook, south of the machine shop area, and is today well-marked by the survival of its red brick, step-gabled northern elevation. However, the make-up of the remainder of the approximately 150-foot (46-meter) long and 50-foot (15-meter) wide building was not identified at the time of the CRMS survey and may have been wood-frame instead of brick. Rutsch et al. noted that the pattern shop straddled the boring mill's tailrace, suggesting that its designers utilized the flow of its discharged water for generating power (1979:168).

Background research of the machine shop (or sometimes *turning* shop) area identified the earliest of its buildings as a single-story brick building erected prior to 1839 east and parallel to the boring mill, measuring 60 feet by 37 feet (18 meters by 11 meters) with a tin roof (Rutsch et al. 1979:174). A ca. 1839 addition adjoining its southern end (also described as a *finishing shop*) measured 251 feet by 54 feet (77 meters by 16 meters), with a 31-foot (9-meter) ceiling, three tiers of windows, and a stepped-gable southern elevation. At the time of the ca. 1839 addition, the earlier machine shop housed 13 lathes and one drilling machine, while the larger, later machine shop housed four planing machines, four vertical drilling machines, and one horizontal drilling machine (likely a type of boring machine) (Blake 1849:243). These two adjoining buildings made up the machine shop area through the period of the Civil War and also housed much of the finishing of Parrott guns during the war.

Like pattern-making, Rutsch's investigation showed that the blacksmith shop area is difficult to characterize until about 1839. At that time, the blacksmith shop featured a rectangular brick building, measuring approximately 128 feet by 54 feet (39 meters by 16 meters), aligned east-west, with several smaller adjoining additions, including one along the eastern end that contained a steam engine and boiler. The largest building enclosed a water-powered trip hammer (with an adjacent waterwheel), two tilt hammers, and a recently-added steam-powered hammer, with an adjoining steam engine (Blake 1849:241, 243; Rutsch et al. 1979:191–192). However, investigators in 1978-1979 were not able to conclusively associate extant above-ground features in the blacksmith shop area with period descriptions of the same area.

Fieldwork directed by Rutsch also entailed the completion of archeological test units in the moulding shop and machine shop areas that provided a preliminary characterization of buried features and deposits of the site. Excavations within the ca. 1839 addition of the moulding shop discovered an intact cast-iron grate and box near a chimney base, as well as a hard-packed clay working surface approximately 18 inches (46 centimeters) below the existing surface. Excavations in the ca. 1839 machine shop addition documented portions of intact wooden flooring beneath "debris from its industrial activities" abutting its western wall (Rutsch et al. 1979:182).

Apart from informing the field survey strategy, the authors of the report used background research and period mapping sources (such as the ca. 1853-1859 Bevan map of Cold Spring and the West Point Foundry for resources pre-dating the Civil War) to construct an in-depth historical narrative and building chronology of the site that remain highly useful for reference and guidance. Overall, the survey directed by Rutsch demonstrated the outstanding archeological integrity of the site (as opposed to similar foundry sites that had been intensive redeveloped), while also providing directions for future research, beginning with the site's extensive and intact waterpower system.

Investigation of the Civil War-era Gun Testing Platform by Grossman and Associates (1989–1990)

As compliance with federal legislation (i.e., the NHPA of 1966, as amended, and the NEPA of 1970), federal agencies take into consideration potentially adverse impacts of their undertakings on cultural resources. In fulfilling its obligations under the NHPA, the United States Environmental Protection Agency (EPA) in the early 1990s sponsored the archeological identification and investigation of peripheral areas within the current boundary of the West Point Foundry Archeological Site prior to completing intensive remediation of the former Marathon Battery Corporation plant site (active from 1952 to 1979 in the production of nickel-cadmium batteries for defense and commercial applications) and nearby Foundry Cove.

As a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-initiated project (e.g., *Comprehensive Environmental Response, Compensation, and Liability Act*, more commonly known as "Superfund"), the EPA and its contractors completed its remediation project by 1996 (EPA 1996). One area that archeologists investigated prior to remediation encompassed the buried but well-preserved remains of the West Point Foundry's Civil War-era gun testing platform, an archeological feature unique to a major ordnance manufacturer of the period. Other major competitor firms, such as the Fort Pitt Foundry and the South Boston Iron Company, conducted proving of their ordnance at off-site locations, such as the Allegheny Arsenal, outside of Pittsburgh, and Nut Island in Boston Harbor.

The gun testing platform was a critical operational area of the West Point Foundry during the Civil War, providing the means to prove the largest models of Parrott guns (100 to 300 pounder models), on site, prior to delivery to the Army or Navy. As noted earlier, President Abraham Lincoln himself observed the testing platform in June 1862 following an official visit to nearby West Point (Gary 2002:273). The Foundry tested ordnance pieces by firing multiple rounds from it, aiming at targets set up on the nearly vertical southeast face of Crow's Nest, a mountain approximately 1.25 miles (2 kilometers) to the west-northwest, opposite Cold Spring on the west side of the Hudson River. Incidentally, cadets at West Point also used targets positioned on Crow's Nest in the course of completing artillery training during the mid-nineteenth century.

Through the direction of Joel Grossman, the principal investigator of the EPA-sponsored study, archeologists carefully identified and documented the well-preserved in situ timber and ferrous remains of the gun testing platform between 1989 and 1990 (Grossman 1991:72–87). Background research conducted prior to the excavation indicated that the West Point Foundry, likely with significant input from Robert Parrott, undertook the construction of a stout horizontal gun testing platform, able to withstand several dozen firing tests each day for the duration of the conflict without complete replacement. During their investigation, Grossman identified a wooden, crib-like structure built of five large timber beams, mortised together and further secured with the use of six wooden keys. The overall structure, both wooden and ferrous components, was discovered to be in a remarkable state of preservation, largely due to the lack of oxygen, or hypoxic, conditions formed by the burial of the feature following its use during the Civil War. The investigation also identified two threaded wrought-iron rods that passed through the lateral timbers of the platform and were likely intended to prevent the larger wooden beams of the platform from spreading or dislodging during the repeated testing of ordnance (Grossman 1991:77). The archeological investigation revealed that the platform included two sets of flat, circular iron rails (described by Grossman as the primary or *outer* gun rail and the secondary or *inner* gun rail) that accommodated the carriage built for holding each piece of ordnance undergoing proving. The rails provided a flat, unimpeded surface about which to pivot the carriage, allowing testing crews to alter the lateral direction of fire at Crow’s Nest Mountain. The testing carriage itself rested on a vertical cast-iron pintle, set in the approximate center of the platform, around which the testing carriage rotated. His careful study of its overall construction and likely modifications led Grossman to the conclusion that the gun testing platform had been built in two distinct phases over the course of its use, with the outer, primary rail, preceding construction of the secondary, inner rail assembly (Grossman 1991:82). Grossman did not find evidence of the length of time separating the two construction phases, however.

Following his intensive investigation and documentation of the gun testing platform, Grossman directed the reburial of the archeological structure with the use of a clay cap that involved a mixture of fine-graded green clay covering the gun testing platform that was intended to recreate the hypoxic conditions that had preserved the structure since the end of the Civil War and provide a distinct discontinuity with the color and texture of the surrounding soil stratigraphy, a thoughtful attempt to alert future excavations to the presence of a unique archeological resource (Grossman 1991:86). Between 1991 and 1992, a quarter section of the intact gun testing platform was re-exposed, removed, and retained for conservation and future public interpretation.

<u>Investigation of the Rascal Hill Area by Grossman and Associates (1989–1990)</u>

Apart from the West Point Foundry’s gun testing platform, Joel Grossman led archeological investigations of select portions of Foundry-related domestic sites located in an area historically known as *Rascal Hill* (or sometimes *Foundry Hill)*, [redacted]. As with the identification and documentation of the gun testing platform, these investigations were undertaken prior to the EPA’s Superfund remediation of the nearby Marathon Battery Corporation plant site in the mid-1990s. Grossman’s subsurface investigations involved assessment and identification of the Rascal Hill domestic area through background research and archeological testing, followed by an intensive data recovery that included block excavations of [redacted] as well as investigations of adjacent contemporaneous features. These efforts altogether yielded over 145,000 artifacts, 127,000 of which could be definitively associated with occupation of the Rascal Hill domestic sites (Grossman 1991, 1993; Norris 2009:174).

Grossman demonstrated through analysis of this rich and diverse artifact assemblage that West Point Foundry period occupation of Rascal Hill could be divided into three distinct phases: a relatively long antebellum period of occupation, spanning construction of the houses ca. 1820 through 1856; a period spanning 1856 to 1876, largely dominated by the period of the American Civil War; and a third phase, spanning the mid-1870s through ca. 1894, at which time material evidence suggested that the dwellings were dismantled, demolished, or abandoned (Grossman 1993:28). He also demonstrated that artifact deposition continued in the Rascal Hill area after the mid-1890s (forming a fourth period of deposition), largely composed of materials post-dating the “destruction of the historic community.” Excavation of the Rascal Hill area [redacted] these prehistoric materials do not contribute to the present NHL nomination but may contribute to a future NR or NHL nomination.

The portion of the Rascal Hill artifact assemblage associated with the antebellum and Civil War periods of the West Point Foundry provided unexpected insights into the domestic lives of workers. The research value of this assemblage was heightened by the overall lack of primary source material that could provide specific information as to those individuals who occupied the different domestic sites investigated during the data recovery. Although Grossman and other researchers have consulted them as sources, U.S. Census Bureau data only capture occupant information at 10-year intervals, diminishing its research potential with respect to industries with high rates of worker turnover, such as foundry and ironworking industries prior to the American Civil War (Grossman 1993; Meyer 2006; Norris 2009). Further refining his analysis of the assemblage, Grossman demonstrated that overall patterns of consumption, as indicated through the types, styles, and date ranges of recovered ceramics, remained consistent from 1820 to the Civil War period, with a preference for foreign-made wares (English and a wide variety of European-made ceramics, for instance) that shifted after the Civil War to domestic-made ceramics (including refined earthenware vessels ["whitewares"] and stoneware vessels) originating in New York, Pennsylvania, and Ohio (Grossman 1993:115–136).

The overall value of the recovered ceramics was higher than expected, with reference to George Miller's broadly used characterization of late eighteenth and nineteenth century ceramics traded in North Atlantic market economies and subsequent application of Miller's studies to other historic-period archeological sites (Heberling 1987; Miller 1980, 1991). Simultaneous with this shift in ceramics consumption, occupants of the Rascal Hill domestic sites moved gradually away from glasswares manufactured within New York and New England, to those manufactured in Middle Atlantic States by the 1860s. Excavations of the Rascal Hill domestic sites also led to the recovery of numerous items associated with scientific, technical, and ordnance production activities, strongly suggesting that the male occupants of the dwellings prior to and through the period of the Civil War were more highly skilled than semi-skilled or unskilled laborers (Grossman 1993:123–126). Artifacts recovered from at least two, possibly three, of the domestic sites suggests that its occupants were involved in manufacturing and proving Parrott guns and other types of ordnance during the Civil War (Grossman 1993:127–129).

The quantity and scope of the Rascal Hill artifact assemblage and its related feature data are challenging to summarize. But the importance of these data to the West Point Foundry Archeological Site lie in their ability to provide an understanding of the domestic lives of Foundry's workers who participated in the skilled worker networks previously discussed that enabled the West Point Foundry to remain a competitive and dynamic enterprise of foundry and ironworking talent through the Civil War. Skilled workers likely resided elsewhere in Cold Spring, too, but most of these dwellings are not within the present boundary of the West Point Foundry Archeological Site. [redacted]

Investigations of the Waterpower System by Michigan Technological University (2003)

In a diary presumed to have been kept by Gouverneur Kemble during the summer 1817, the author describes the earliest efforts in planning and breaking ground of the West Point Foundry as an entirely new industrial enterprise in the Hudson Highlands (Walton 2009b). In this short diary, Kemble focused a great deal of attention on the layout and progress in building the Foundry's waterpower system (Walton 2009c). No specific plan or elevation drawings survive from Kemble's diary or other sources of this early period in the Foundry's first phase of construction. However, the diary does include elevation measurements recorded at various intervals along the course of the brook, and were likely useful in gauging the power potential, or *head*, of the brook as it descended toward Foundry Cove to the south. Considering Kemble's brief notes as well as the surviving archeological structures and features of the waterpower system, the West Point Foundry Association intended its new foundry and ironworking enterprise to be powered almost exclusively by water. The reasons for this choice remain unclear when steam power was becoming an increasingly attractive power generation option with many advantages for manufacturers. But concerns over uninterrupted access to sources of mineral coal for fueling steam engines, as well as their technological novelty, may have influenced decision-making, especially with the commerce interruptions of the War of 1812 and the earlier Embargo Act of 1807 fresh in their minds (see Hunter 1979). An equally likely advantage of waterpower embraced by the Association were cost savings as the waterpower potential of the brook could be harnessed for no more cost than the investment in dams, raceways, and vertical waterwheels; once capital improvements were complete, waterpower for the Foundry's owners was essentially free.

To adapt the stream privilege rights granted by the State of New York in the West Point Foundry Association's initial corporate charter of 1818, the Foundry's designers built two dams along the course of Foundry Brook they included what is commonly known as the Main Dam, located beneath the present NYS Route 9D bridge over Foundry Brook; the Upper Dam is located farther upstream approximately 950 feet (290 meters). The dams were constructed with cyclopean-style masonry: coarsely faced blocks of locally quarried granite and granite gneiss, typically measuring over four feet (1.2 meters) in any given dimension, dry-laid, and set with chinking stones. The dams were likely built as checks on the flow of the brook, while also acting as a collective, interconnected reservoir. Both dams remain extant and constitute two of the three structures that contribute to the NHL.

Below the Main Dam, at an elevation of 115 feet (35 meters) above Foundry Cove (approximately sea level), water flowed from Foundry Brook into a stone-lined raceway along the west bank of the stream. From the crest of the Main Dam to the vertical backshot waterwheel in the boring mill, water followed a course of approximately 820 feet (250 meters), descending 92 feet (28 meters) in elevation along a grade of eleven percent within the interconnected stone-lined raceways (Finch 2004:143). Built on graded bedrock (flowing beneath the Foundry's blast furnace), the raceway followed a slightly descending slope to the south that guided water into Battery Pond, an elevated, stone-lined reservoir, also constructed of striking masonry and the third of the structures that contribute to the NHL (Finch 2004; Hartnell 2006). As its name suggests, Battery Pond provided a reservoir of water for the vertical waterwheels located below the reservoir within the Foundry layout. Interestingly, field investigators in 2006 identified a dense layer of ferrous material covering interior portions of Battery Pond. Later analysis was inconclusive as to how the material was applied to the surface of the stone work but may have been deposited in a near molten state or as machining waste that oxidized and bonded together, like the swarf deposits in the boring mill and machine shop areas.

An elevated flume that led away from Battery Pond channeled water to the blacksmith shop (providing power for its trip and tilt hammers, numbering four by the late 1840s[28]), while also guiding water to the largest of the Foundry's waterwheels, a 36-foot (11-meter) diameter, 8-foot (2.4-meter) wide vertical backshot waterwheel set within the boring mill's main building (Blake 1849; Finch 2004; Herzberg 2005; Trepal 2008b). This waterwheel, centered within a deep rectangular stone-lined wheel pit, provided power to the boring machines, or *beds*, and several large cranes used for moving castings. The boring mill water wheel may have also generated power for the nearby machine shop, transmitted through overhead line shafting that connected the two buildings (Kotlensky 2013).

<u>Investigations of the Boring Mill by Michigan Technological University (2003–2008)</u>

With construction of the moulding shop also underway, the West Point Foundry's early managers undertook building construction of a two-story stone masonry building in 1817 that housed the 36-foot (11-meter) diameter backshot waterwheel and several horizontally oriented boring machines designed for boring cannons,

[28] Water-powered trip and tilt hammers preceded the adoption of steam hammers in the West Point Foundry blacksmith shop. A steam-driven hammer is prominently depicted in the Foundry's blacksmith shop in John Ferguson Weir's painting, *Forging the Shaft* (1874-1877).

and later, steam engine cylinders (Herzberg 2005). The boring mill's waterwheel was likely one of the largest of the period and the Hudson River Valley until Henry Burden constructed an overshot waterwheel 62 feet (18.9 meters) in diameter and 22 feet (6.7 meters) in width in 1851 to generate power for his horseshoe and spike manufacturing enterprises in Troy, New York (Hunter 1979:571). The boring mill structure protected the boring and turning machinery but also provided all-season protection for the waterwheel and connected line shafting that transmitted power from the waterwheel to machinery, while keeping the carefully joined wooden segments of the wheel saturated with water, aiding its preservation and operation (Gordon and Malone 1994:16–20; Herzberg 2005). Archaeological investigations of the boring mill characterized the large rectangular stone-lined wheel pit, the tailrace opening, identified numerous machine tie rods and brick-lined pads that supported the boring, turning, and planning machinery, and numerous deposits of swarf that remained in situ following the boring or machining of a casting, unless removed for discard or recycling in the furnaces of the moulding shop (Herzberg 2004; Kotlensky 2013; Trepal 2008b).

Remarkably, excavations of select areas of the boring mill in 2004 uncovered deposits of swarf deposited in between the floor joists of the boring mill that had oxidized and fixed into large masses, forming a type of stratigraphy unique to the boring mill (Herzberg 2005). Mechanical excavations of the boring mill waterwheel pit in 2012 in support of interpretive features led to the recovery of preserved segments of the last iteration of the boring mill's waterwheel (Kotlensky 2013). The two curved segments, one measuring approximately 14 feet (4.3 meters) in length, the other 17 feet (5.2 meters), were constructed as the outer rims, or *shrouds*, of the waterwheel, and had been preserved in a relatively sealed archeological context in masonry rubble and lying below the surrounding water table line within the waterwheel pit, thereby preventing further decay (Kotlensky 2013). The shroud segments were retained for further conservation and study and represent rare surviving segments of a large-diameter wooden waterwheel.

Archeological study of the boring mill in 2004 also offered the opportunity to compare the West Point Foundry's boring mill with that of other contemporary boring mills as presented in literature of the period, leading Herzberg to conclude that the boring machinery and layout at the West Point Foundry was similar to other boring mills, such as those that are likely missing from the sites of the Fort Pitt Foundry and South Boston Iron Company (Herzberg 2005). The area of the boring mill possesses a high archeological study value since few if any contemporary cannon-boring sites like it remain for study (see Herzberg 2005).

<u>Investigations of the 1865 Office Building by Michigan Technological University (2003 and 2004)</u>

As the Civil War ended, the West Point Foundry under Robert Parrott's leadership completed a new administrative building east of Foundry Brook (Photograph 17). Commonly known as the *1865 Office Building* for the cast-iron plate set above its entrance (embossed: "OFFICE. 1865"), the two-story, red brick Italianate-style building replaced an earlier single-story frame building located south of the brick ca. 1839 machine shop (Scarlett et al. 2009:108). The new building featured a distinctive wood-framed cupola that was visible to those traveling by on the Hudson River Railroad and the river itself. The architectural style of the office building added to the simpler Dutch-inspired step-gabled brick facades featured in the moulding, machine, and pattern shop buildings of the period. Researchers led by Timothy Scarlett have argued that the new administrative building was intended to demonstrate the Foundry's presence and permanence in contrast to its ever-changing sprawling industrial surroundings (2009:109). The Italianate design of the office building matched many of the private residences that had been built in Cold Spring in the 1850s and 1860s, including Parrott's nearby home, *Plumbush*, also finished in 1865 and designed by local architect George E. Harney (Kuhn 1991).

Archeological investigations carried out near the base of the building did not recover a significant quantity of cultural materials dating from the site's period of national significance (Scarlett et al. 2009:112). These excavations did reveal the large builders' trench used to excavate the dressed stone foundation and a significant amount of discarded industrial waste, such as slag and fragments of firebrick, predating its construction. Although its immediate area has not demonstrated a distinct pre-1865 archeological value, the 1865 Office Building is the only contributing building to the proposed NHL and is representative of the West Point Foundry at its peak of national influence and recognition. In 2016, Scenic Hudson supported restoration of the cupola and its remounting on the 1865 Office Building.

Investigations of the Blast Furnace Area by Michigan Technological University (2004 and 2005)

In his diary of the setting out of the West Point Foundry, Gouverneur Kemble remarked in his June 9, 1817, entry that "[M]uirhead pointed out the ground & gave me a general idea of his plan for a blast furnace to be worked by water from the main dam" (Walton 2009c:16). Though his role in the design of the early Foundry remains poorly understood, James Muirhead's suggestion for a nearby blast furnace was not disregarded by Gouverneur Kemble. By 1825, stonemasons were undertaking the construction of a 40-foot (12-meter) tall stone blast furnace stack, lined with refractory fire brick, and as Muirhead planned, laid out to have its blowing engine driven by water drawn from the Foundry's nearby Main Dam. In October 1827, the Foundry's Cold Spring blast furnace began its first campaign and had by the account of Samuel L. Gouverneur, Gouverneur and William Kemble's maternal first cousin and recent personal secretary to President James Monroe, succeeded in making the quality of pig iron needed by the Foundry (Kotlensky 2007).

Local periodicals of the early 1820s suggest that the West Point Foundry's early leadership was content to purchase pig iron from nearby blast furnaces, while Gouverneur Kemble's earlier diary of 1817 also records his ideas of importing pig iron from Great Britain and Sweden (Kotlensky 2007). This difference in strategy suggests that Kemble and his associates were eager to secure a specific quality, or *grade* in period literature, of pig iron for their new foundry and that lower grades of pig iron would not suffice, especially for fulfilling their closely inspected ordnance contracts. They opted for a new strategy when in 1825 the Kemble brothers purchased the existing charcoal-fueled Greenwood blast furnace (built in 1811), in nearby Orange County, New York, west of the Hudson River, at about the same time construction of their Cold Spring blast furnace got underway (Ransom 1966:140–142). Researchers of the West Point Foundry have discovered no written sources to date that speak to a specific desire by the Foundry's early leadership to control pig iron production, when many of the emerging foundry owners throughout the Northeast and Middle Atlantic appeared content to purchase pig iron on an open market, as the Fort Pitt Foundry and South Boston Iron Company did (Hunter 1985:183–193).

Quality control, indeed, was likely a guiding motivation for the Foundry's owners as Samuel Gouverneur remarked in a letter in October 1827 to Samuel Wright, a prominent Philadelphia ironmaker, that the new furnace in Cold Spring was producing "a soft Grey pig" iron that "will answer well for Cannon" (as cited in Kotlensky 2007). The blast for the furnace was generated by a 36-foot (11-meter) diameter, all-iron waterwheel, provided with water from the Main Dam, upstream (Ganzel and Wulff 1832:23). With the blast furnace in operation on Foundry Brook in the autumn of 1827, William Young, the furnace's designer (and the Foundry's first superintendent), managed a single consolidated enterprise where artisans rendered pig iron from ore to cast into cannon, solely using waterpower.

Archeological investigations of the blast furnace area, carried out in 2004 and 2005, revealed that the blowing engine of the furnace had been built atop the stone-lined raceway that guided water from Foundry Brook to Battery Pond, farther to the south. A raceway channeling water beneath a furnace foundation was an unusual and potentially hazardous arrangement for blast furnaces of the period, but this unique layout functioned successfully for at least 17 years (Kotlensky 2007; Timms 2005).[29] The investigation in 2004 of the blowing engine also recovered two intact pigs from the course of Foundry Brook adjacent to the blast furnace area: one formed in an angle, the other embossed with "WPF 1828," indicating that it had been cast in the first or second campaign of the blast furnace. Excavations of the blast furnace casting arch and adjoining areas revealed a charcoal-fueled blast furnace layout common to the period, with a deep bed of fine, yellowish-brown casting sand (extending 7 feet [2.1 meters] below the surface in one tested location) set at the edge of the casting arch, that accommodated the several tons of pig iron that the furnace workers cast at least twice daily (Kotlensky 2007).

While they were becoming an increasingly common industrial feature of the American antebellum economy, the incorporation of an exceptionally large blast furnace (most charcoal blast furnace stacks of the period were 35 feet [11 meters] or less in height) into the layout of the West Point Foundry demonstrated a willingness by the Foundry's leadership to engineer the narrow landscape of the property and maximize its production potential, while securing the production of a critical commodity with the quality they desired. By contemporary accounts, the West Point Foundry may also have succeeded in building one of the more efficiently operated charcoal-fueled blast furnaces of the period, as at least two commentators of the period noted that the furnace consumed less fuel than other contemporary charcoal blast furnaces (*The American Quarterly Review* 1831; Overman 1850).

But the archeological investigations of the blast furnace also hinted that its later managers may have been sharing in a unique local practice of mixing charcoal with anthracite coal in the production of pig iron, as suggested by the recovery of thermally fused iron ore, charcoal, and anthracite coal during excavations in 2005 (Kotlensky 2007; Lesley 1859). [30] This material likely remained inside the furnace as its final campaign ceased (in 1844 or later), and then discarded as the furnace stack was salvaged for its masonry. Although recovery of such a small sample cannot be taken to represent a longer-term trend in fuel consumption, its presence hints at a willingness, if only short term, to use a fuel mixture likely aimed at reducing costs (as anthracite coal was decreasing in cost in comparison to charcoal during this period in the Hudson Highlands) but maintaining the production of pig iron suitable for the manufacture of ordnance.

Discontinuing use of the Cold Spring blast furnace for cost reasons also suggests that the West Point Foundry's leadership was responding to increased competition in an economy that remained unstable for heavy capital goods and ordnance contracts in the years following the Panic of 1837 (see Turner 1989:67). Despite the abandonment of their Cold Spring blast furnace in the mid-1840s, the Kembles and Robert Parrott financed the construction of an anthracite-fueled blast furnace, the *Greenwood No. 2*, in nearby Orange County in 1854 (Kotlensky 2007; Ransom 1966). The Greenwood No. 2, along with the older, nearby charcoal-fueled Greenwood No. 1, supplied the West Point Foundry with much of its pig iron supply for the next three decades, demonstrating a renewed interest on the part of the Foundry's leaders to control their pig iron supply as they had with their Cold Spring blast furnace.

[29] Blast furnace designers took great care to minimize, if not eliminate, the risk of contact between the interior of a furnace and ground water (Overman 1850). Water that contacted the molten and combusting materials within the furnace could cause a steam-driven explosion, or at a minimum, erode the masonry construction of the furnace stack and its interior firebrick lining.

[30] John P. Lesley listed six blast furnaces in the nearby Salisbury ironmaking district of southwestern Connecticut and southeastern New York that successfully produced pig iron with a combination of charcoal and anthracite coal for fuel, an approach unique to the region in the mid-1850s (1859:31–34).

Investigations of the East Bank House by Michigan Technological University (2005 and 2006)

Researchers with Michigan Technological University undertook two seasons of intensive investigations of the East Bank House and its surrounding area. Identified in period photographs as [redacted] Named by researchers as the *East Bank House* simply for its location (no historical name for the former dwelling has been identified), the area had not been studied in any prior archeological investigations of the overall West Point Foundry Archeological Site. In 2005 and 2006, Michigan Technological University researchers completed background research and an initial assessment of the area through shovel testing, followed by intensive test unit excavations like those carried out by Joel Grossman during the investigation of the Rascal Hill area.

Background research revealed that the dwelling occupied a T-shaped floor plan that was expanded from a single story to two stories at an unknown date and included three chimneys when the unoccupied building burned in a fire in 1919 (Norris 2009:167–173). Mapping in 2005 recorded the [redacted] Researchers identified [redacted] suggesting that masonry materials used in the construction of the three separate chimneys were likely salvaged after the dwelling burned in 1919. Background research also revealed that the East Bank House had been initially built by the Foundry to house a senior manager (perhaps William Young, the first superintendent), but was later adapted into a boarding house prior to the Civil War, and sometime after the 1880s the house became a private residence, with no direct connection with the operation of the West Point Foundry thereafter. Analysis of the artifact assemblages recovered from the East Bank House area has both reinforced the recorded history of the domestic area while providing a more refined understanding of its three periods of occupation.[31]

Analysis of the ceramic assemblage recovered from the area (totaling 5,095 fragments recovered to date) demonstrates that from approximately 1820 to 1840, the East Bank House was likely occupied by a member of the West Point Foundry with a relatively high income, compared with the lower-paid but skilled workers who occupied the dwellings in the Rascal Hill area (Norris 2009:183). Norris' conclusion is supported by the roughly equal number of recovered bowls and plates dating to this early period, with varying numbers of vessels possessing transfer prints and hand decoration, indicating higher valued pieces; ceramics recovered from the 1820 to 1840 period also contained the highest volume of porcelain vessels compared to the following two periods of occupation, also suggesting higher income of the occupants. The second period of occupation, spanning the 1840s to the 1880s, corresponds to the adaptation of the East Bank House for the boarding of Foundry workers, many of whom were likely semi-skilled workers or unskilled laborers (Norris 2009:167–173). The ceramic assemblage associated with this second period includes a larger number of serving pieces in comparison to the earlier period of occupation, including bowls, flatware, pitchers, jugs, and crocks, as well as chamber pots. This increase is not surprising, as a boarding house would have involved the preparation of larger meals for single men who dwelt in the house in the years preceding the Civil War.

The roughly equal proportion of bowls to plates likely indicates that boarders were consuming a large volume of cut meat dishes, complementing meals prepared in stew or soup fashion (Norris 2009:183; see also Reitz 1987 and Schulz and Gust 1983). Analysis of assemblages dating to the first and second periods of occupation of the East Bank House contrast with that of the Rascal Hill area in marked ways. Interestingly, the East Bank

[31] Discussions of only the first and second periods of occupation of the East Bank House site are included here as these periods correspond to the period of national significance of the West Point Foundry Archeological Site.

House assemblage contains ceramics that originated in Great Britain and the United States only, suggesting greater continuity in ceramics consumption (and perhaps occupation as well) over time compared with the Rascal Hill domestic area situated on the opposite side of Foundry Brook (Norris 2009:187). Overall, the artifact assemblage of the East Bank House has provided much-needed data for comparison with that of the Rascal Hill assemblage, yielding data on the material culture of temporally contrasting occupants (management, followed by labor) within habitation areas adjacent to the West Point Foundry during its most prosperous and influential period.

Investigation of the Vinegar Hill Area by Michigan Technological University (2005)

Period maps of the West Point Foundry dating to 1854 and 1867 depict [redacted] Its habitation by workers and their families is strongly suggested in period sources and its initial construction was likely an early effort undertaken by the West Point Foundry Association to provide housing in a nascent industrial community with limited choices for newcomers (Norris 2009:218). [redacted]

A preliminary field survey of the Vinegar Hill area was completed by Michigan Technological University in 2005. The goals of the survey were to map dwelling foundations and other surface features, and carry out limited archeological testing (Deegan and Kotlensky 2005:37–44). Researchers identified at least five dwelling foundations, one privy vault and possibly 10 additional others, and surface scatters of domestic- and architectural-related artifacts. Excavations recovered similar types of artifacts in shovel test and excavation units that Elizabeth Norris used to compare with the assemblages of the Rascal Hill and East Bank House areas. She demonstrated that the occupants of the Vinegar Hill area consumed a comparatively higher percentage of less-costly, undecorated whitewares, suggesting lesser paid workers occupied the houses (Norris 2009:220). However, she noted that future field study of the Vinegar Hill area is necessary to draw a more statistically comparable assemblage of artifacts.

Reinvestigation of the Machine Shop Area by Michigan Technological University (2006 and 2008)

In support of proposed stabilization and interpretation efforts by Scenic Hudson, investigators excavated select portions of exposed and buried wall footings along the western margin of the machine shop area (Norris et al. 2006 and Trepal 2008b). These excavations yielded many of the same types of artifacts and stratified deposits and machinery footing features discovered by Rutsch et al. in 1979 but helped refine an archeological understanding of the progression of additions in the machine shop area. A building dated in ca. 1885 in the 1979 CRMS study was discovered to date in construction between 1853 and 1867 based on a closer review of historical documents and documented features, such as masonry building footers (Norris et al. 2006). This information has helped clarify which portions of the machine shop area are associated with the West Point Foundry's period of national influence.

Investigations of the Moulding Shop by Michigan Technological University (2007)

As Rutsch's previous investigation documented through research, the stone and brick buildings of the Foundry's moulding shop housed its air and cupola furnaces, handling equipment (principally ladles moved with the use of wooden jib cranes) for casting molten iron into any number of articles in sand or loam molds (Rutsch et al. 1979; Trepal 2008a). The buildings of the moulding shop provided space for skilled moulders to prepare sand molds of items to be cast (Rutsch et al. 1979). The moulding shop and multiple smaller additions adjoined one another in early mapping and period photography of the Foundry (Bevan 1854).

Through analysis of period mapping of the Foundry and structural remains of the overall activity area, researchers in 2007 documented the expansion of the moulding shop over the antebellum period, beginning with the initial two-story stone masonry casting house built in 1817, followed by the construction of two adjoining buildings by 1839 (2008:73–74). The earliest arrangement, though, remained largely unchanged through the period of the Civil War. The 2007 investigation and research suggested that the ca. 1839 expansion allowed for the addition of two cupola furnaces, intended for casting products that could tolerate a higher amount of sulfur, imparted from mineral coal (likely anthracite) used in these shaft furnaces[32]. The West Point Foundry continued to use horizontal air furnaces in the original 1817 moulding shop building for the manufacture of ordnance through the period of the Civil War (*Harper's Weekly* 1861; Trepal 2008a).

Archeological investigations in 2007 revealed intact features associated with both the large chimney built for the air furnaces that dated to ca. 1817, as well as one casting pit used to cast ordnance and possibly steam engine cylinders (Trepal 2008a:74). The archeological remains of this pattern of expansion and retention of existing buildings demonstrated the response of the West Point Foundry's managers to increased demand for heavy capital equipment apart from ordnance, allowing it to participate in the growing industrialization of the American economy. The makeup of the moulding shop space also represents a unique archeological resource that has yielded data, largely through structural and feature evidence, of how the West Point Foundry successfully managed the casting of ordnance as well as advanced industrial goods for national markets (Trepal 2008a).

The Foundry Dock as a Contributing Resource

The West Point Foundry began construction in 1848 of an approximately 600-foot (183-meter) long dock into the Hudson River that was likely spurred by the impending completion of the Hudson River Railroad across Constitution Island and north into Cold Spring that would cut off direct access between the Foundry's earlier dock built into Foundry Cove and the Hudson River (Blake 1849:245). The enlarged dock provided continued access for sloops and other vessels to deliver raw and semi-finished materials to the Foundry while transporting away ordnance and goods, whether assembled or disassembled (Photograph 18). No archeological investigations have been undertaken of the upland portion of the Hudson River Foundry Dock that is within Scenic Hudson's Foundry Dock Park. Although it has not been subject to previous investigations, the Hudson River dock is listed as a contributing resource to the NHL as its operation was associated with the West Point Foundry's period of national significance and may yield data through future terrestrial and underwater investigations of the remains of the dock and surrounding areas.

Noncontributing Resources

Although it dates to the site's period of national significance, the boiler shop that is depicted in period mapping and described in secondary sources (such as Blake 1849) is not listed as a contributing resource since it has not been identified in archeological studies of the site and was likely intensively redeveloped with expansions of the moulding shop after 1867. Major industrial activity areas of the West Point Foundry that postdate 1867 are also not included here as contributing resources and include the Cornell-period (ca. 1889 to 1911) bridge fabrication and erection shop located near Foundry Cove Marsh and a japanning shop for applying lacquer to furniture and

[32] Sulfur content in cast iron can induce elevated brittleness under compression, a condition that gun founders were eager to avoid in their finished cannons, destined for proving by Army and Navy ordnance inspectors.

other consumer goods produced by the Foundry in the 1890s and 1900s. An extant brick-clad boiler house dating to the Cornell period is located south of the ca. 1853 pattern shop area and does not contribute to the present NHL nomination; the building continues to contribute however to the NR-eligibility of the site (Barry 2009).

The Middle Archaic-period site identified in the Rascal Hill area and a broadly dated Archaic-period site identified [redacted] are also not included as contributing resources to the NHL, though they may be eligible for listing in the NR or merit recognition as contributing to a future NHL (Grossman 1991; Norris and Martin 2007).

The 2010 NR form completed for the West Point Foundry Archeological Site includes the nearby Chapel of Our Lady Restoration (immediately north of Foundry Dock Park, facing the Hudson River) and the former Foundry School Museum (currently housing the Putnam History Museum, located at 63 Chestnut Street in Cold Spring) as contributing *properties*. However, neither property is included as contributing resources to the present NHL nomination because both properties lacked clear support for inclusion in the 2010 NR and neither is within the property owned by Scenic Hudson associated with the West Point Foundry. Future expansion of the West Point Foundry Archeological Site as a *District* though should take both properties into consideration for their association with the workers of the West Point Foundry.

Site Integrity

In comparison to sites similar in theme and period, the West Point Foundry Archeological Site presents outstanding archeological integrity (NPS 2000b). Although its immediate area has not demonstrated a distinct pre-1865 archeological value, the 1865 Office Building is the only contributing building to the proposed NHL and is representative of the West Point Foundry at its peak of national influence and recognition. As a contributing resource it retains high integrity to its exterior materials and workmanship. In 2016, Scenic Hudson supported restoration of the cupola and its remounting on the 1865 Office Building. As demonstrated in previous discussions, the *location* of the site remains as it did during its period of national significance (1817–1867). The *design* of the site is conveyed through its intact layout and further demonstrated through several extant masonry features associated with its interconnected activity areas. Unlike many similar industrial sites that have been graded for redevelopment, the building and structural footers of the site remain largely intact (though concealed) and serve as waypoints for guiding research and informing visitors. The *setting* of the site is remarkably preserved through major terrain and built features, such as Foundry Brook, Foundry Cove, the Hudson River, and adjacent railroad corridor that help define the natural and built landscapes that encompass the site in the past and present and remain much as they were in the mid-nineteenth century.

The *materials* that made up the buildings of the West Point Foundry, such as architectural stone, red brick, and firebrick, remain in abundance despite significant salvage after 1911 and provide direct evidence of construction materials and methods (i.e., lime-based mortar for bonding masonry). With respect to *workmanship*, the site possesses several deposits of materials, such as swarf and slag, which provide direct evidence of ironmaking and ironworking methods and skills that represent operation of the West Point Foundry. The *feeling* of the site is also retained as little development since the early twentieth century has disturbed or impacted views from within and without the site. Apart from successional forest growth, the place of the site within views from the opposite shore of the Hudson River remains unchanged. Lastly, the *association* of the site with major national events and historical trends has been demonstrated through its substantial and unique contributions to the outcome of the Civil War and American industrialization.

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Personal Communications

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2016 Parrott guns and period ordnance design. Mark Forlow is a trustee of the Putnam History Museum and an independent researcher of the West Point Foundry, the Parrott gun, and contemporary ordnance.

Previous documentation on file (NPS):

_X_ Previously listed in the National Register (fill in 1 through 6 below)
__ Not previously listed in the National Register (fill in **only** 4, 5, and 6 below)

1. NR #: 10000059 (West Point Foundry Archeological Site); 73001250 (West Point Foundry District)
2. Date of listing: February 25, 2010 (for NR #10000059); April 11, 1973 (for NR #73001250)
3. Level of significance: National
4. Applicable National Register Criteria: A_X_ B__ C__ D_X_
5. Criteria Considerations (Exceptions): A__ B__ C__ D__ E__ F__ G__
6. Areas of Significance: Industry

_X_ Previously Determined Eligible for the National Register:	February 25, 2010 and April 11, 1973
__ Designated a National Historic Landmark:	N/A
__ Recorded by Historic American Buildings Survey:	N/A
__ Recorded by Historic American Engineering Record:	N/A
__ Recorded by Historic American Landscapes Survey:	N/A

Location of additional data:

State Historic Preservation Office:	N/A
Other State Agency:	N/A
Federal Agency:	N/A
Local Government:	Village of Cold Spring Highway Department 85 Main Street Cold Spring, New York 10516 (845) 265-4883 (Grossman and Associates 1989-1990 artifact collection)
University:	Michigan Technological University (MTU) Department of Social Sciences 1400 Townsend Drive Houghton, Michigan 49931 (906) 487-2113 (MTU 2002-2008 artifact collections)
Other (Specify Repository):	Putnam History Museum (PHM) 63 Chestnut Street Cold Spring, New York (845) 265-4010 (Miscellaneous records associated with the West Point Foundry) Scenic Hudson Land Trust, Inc. (Scenic Hudson; SHLT) One Civic Center Plaza, Suite 200 Poughkeepsie, New York 12601 (845) 473-4440 (Miscellaneous reports; property owner)

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